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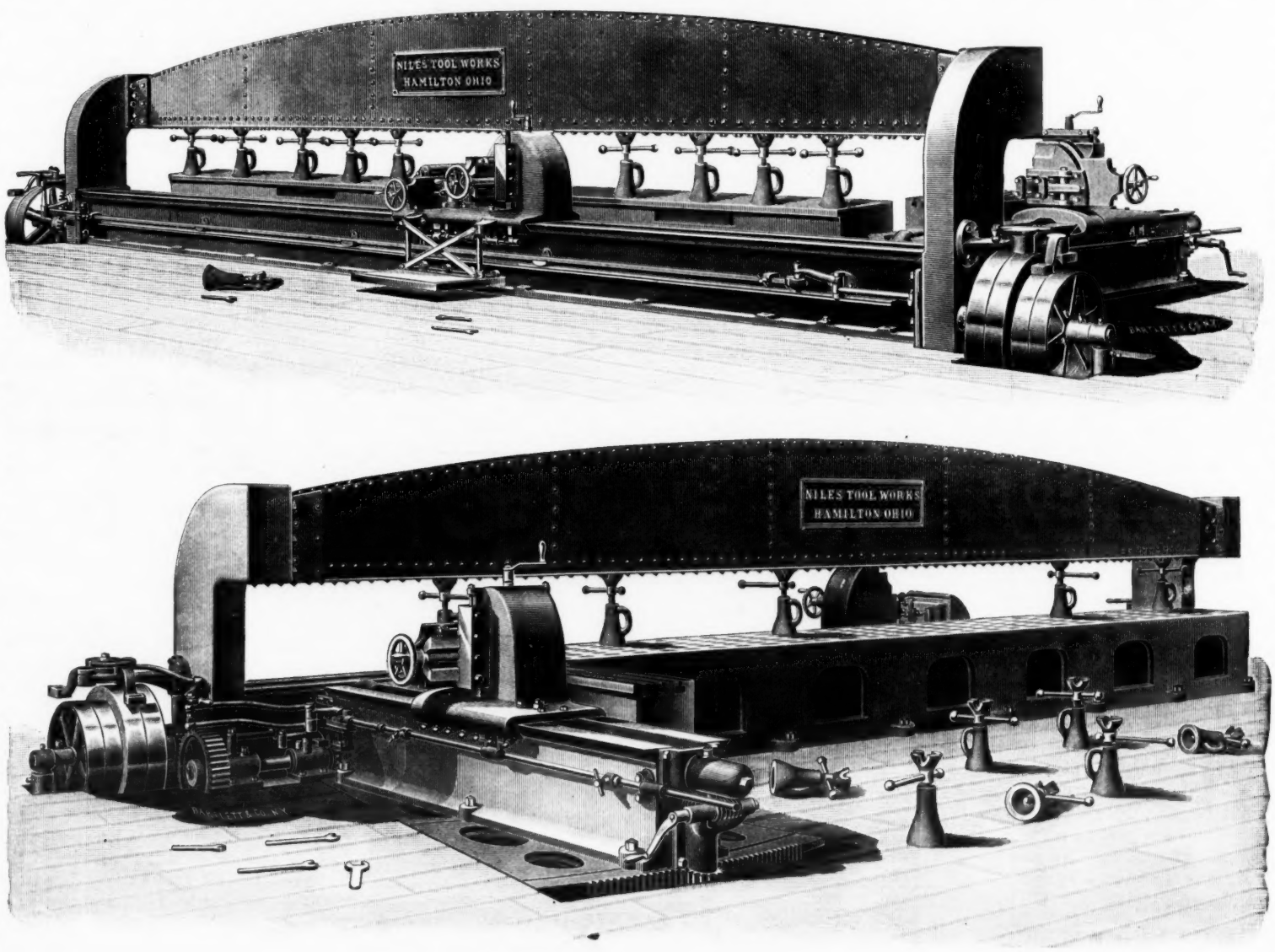
Double Plate Planer.

The illustrations on this page give a front and rear view of a plate planer built by the Niles Tool Works, of Hamilton, Ohio, two machines of this design having been recently furnished to the U. S. Government, one of them for the Boston and the other for the League Island Navy Yard.

The machine consists essentially of a heavy box bed, at either end of which are attached uprights which are joined by the heavy steel box beam seen at the top. Jack-screws placed under this beam and upon the sheet hold the latter firmly in place while being operated upon. The beam overhangs so that sheets of any length may be planed by resetting.



DOUBLE PLATE-PLANING MACHINE.

At one end of the main bed is pivoted a shorter bed upon which is fitted a saddle for planing the end of a sheet at the same setting, and at the same time, this bed being adapted to swing 10° in either direction from 90° by a rack and pinion and worm movement. The bed rests upon a heavy slotted table which is at the floor line, and in its movement carries with it the short slotted platen seen, which is level with the main bed, the end of the sheet being secured to this.

The tool saddles are moved by powerful screws which are supported along their entire length to prevent deflection. The main saddle has two tools and cuts in both directions, one of these tools having an angular movement the same as an ordinary planer while the other moves in a horizontal plane only. There is one tool only in the butt planing saddle and the cutting is done in one direction. This saddle is therefore provided with a quick return movement. There is a safety device, which, should the two saddles approach the corner of the sheet simultaneously, reverses the butting saddle, thus avoiding the possibility of a collision of the tools. Tappets attached to rods automatically reverse the saddle by shifting open and crossed belts.

The machine of course enables sheets to be planed much more accurately as well as much more expeditiously, where the ends are to be planed square or at an angle, than can be done on a single plate planer. As will be seen the machine is of very rigid construction throughout and they are built for the largest and heaviest work, those furnished for the Government being adapted to plane plates 1¼" thick, 24 feet long at one setting, and 6 feet wide.

Rubber Patterns.

BY JOHN T. USHER.

The working and manipulation of rubber is an art which appears to have heretofore been almost exclusively confined to factories and establishments making novelties and specialties for surgical and other purposes for which this material appears to be very eminently adapted. I have not been able to find any reliable treatise or literature on the subject, and I presume that the absence of the same may, to a certain extent, account for the fact that it is not more generally known. Rubber is, perhaps, the most responsive, and at the same time the most refractory of any material known to the arts and sciences. Any small article can be made, or reproduced, or duplicated in its minutest details, whether said article be ornate or plain, regardless of shape or form, or the purpose for which it is used, and it will, therefore, be understood that, though this and the following papers will treat on "rubber pattern work" exclusively, the working and manipulation of rubber will, on general principles, be identical in making, reproducing or duplicating any article in *hard* rubber, or rubber that has to be cured, hardened or vulcanized by subjecting the rubber (after it has been molded to the desired shape or form) to a certain temperature for a given length of time. Rubber has been said to be the most difficult substance or material to work that has ever been discovered. I do not wish to contradict this statement, but will merely say that if it is, then my own experience with other materials has seldom been so successful as it is with rubber. I would also state here at the beginning that, unless the same care and thoughtfulness is exercised in every instance that would be used in any other undertaking where judgment and care are an essential feature of the operation, disappointment may be the rule; but when and wherever attention is paid to all details and instructions given, a failure will be something almost unknown; whenever I have failed to accomplish the object sought, it has been in every instance owing to some oversight or carelessness on my own part. To make rubber patterns, the following articles are necessary: Bees-wax (sheeted), plaster-of-paris, a vulcanizer, some flasks adapted to this kind of work, bolts for the same, an ordinary table knife for mixing the plaster, a wax spatula, Fig. 16, p. 2, an instrument used for spreading and shaping the wax in making or forming preliminary patterns in wax, and a few other articles of minor importance, which will be explained as occasion demands. In making patterns in rubber, it will be necessary in many cases to have or make a preliminary pattern; this preliminary pattern can be made of wood, bees-wax, modeling clay, modeling composition, or, in fact, of any substance or material which can be shaped to the desired form, and can be made to retain its shape or form long enough to allow an impression or cast to be taken or made of the same in plaster (where plaster is alluded to, plaster-of-paris — gypsum — is always meant); in making or forming the preliminary pattern, I prefer the sheet wax, and use that altogether (except where I make the mold in part or wholly of plaster, which will be explained later on).

MIXING PLASTER.

To mix the plaster so as to get the best results requires some little attention, and as any carelessness or neglect in this respect may result in failure of the whole, a few remarks on the subject may not be out of place. First. It is best to procure the plaster that is prepared for the use of dentists, and called "dental molding plaster," which is much finer than the plaster used for ordinary purposes, and can be bought in this city (New York) at $1.75 per barrel.

There are other brands of plaster which sell as high as $6 per barrel—these latter brands are not so well adapted to rubber pattern work (or, in fact, for any kind of rubber work) except where dry heat vulcanizers are used to harden the rubber, as in vulcanizing with wet steam, the plaster softens to such an extent that it cannot be depended on to retain its correct shape or form; personally, I prefer and use the cheaper brand, as I can obtain much better results with it. There are other compounds and preparations manufactured especially for making rubber hand-stamps, etc., which, if used at all, must be used in connection with a dry heat vulcanizer. In mixing the plaster, a bowl (an ordinary soup bowl), a knife for mixing the plaster and some salt (table salt) are required. To mix the plaster, the amount of water necessary to saturate the plaster is first poured into the bowl, a pinch of salt is then added and stirred in with the water. The plaster is then added, not all in a lump, but by shaking it out of a spoon or scoop in order to loosen it as much as possible (in no case must the plaster be placed in the bowl before the water, as it will nearly always come out lumpy after being mixed, and it is also liable to crumble away during the process of vulcanizing); it is best to let it stand a few seconds until the plaster is thoroughly saturated (and no longer), the surplus water (if any) can then be poured off, and the plaster stirred or mixed; if this has been done properly, the plaster will then be of the consistency of thick cream; when the salt has been added it must be used immediately, as it commences to set or harden very quickly. To a person not used to handling plaster, it would probably be better to omit the use of the salt until such time as he has acquired that rapidity of motion which practice alone can give. It is, however, very desirable to learn to use the salt as soon as possible, for when no salt has been added it will take much longer for the plaster to set, and consequently so much time is wasted. There is also considerable scope for a man to use his judgment in gauging the amount of plaster necessary to be mixed at one time, for pouring impressions, making molds, or flasking either casts, molds or patterns, as any unnecessary surplus of plaster means so much waste, and adds to the cost of the patterns.

When much plaster work has to be done, the plaster bowl (or bowl for mixing the plaster in) is preferably a soft rubber bowl—one of these can be bought for fifty cents, and will last a lifetime. When a porcelain bowl is used, the difficulty of cleaning the surplus plaster out of it after the plaster has hardened may be easily overcome by first dipping the bowl in water, which loosens the plaster, otherwise it will be found to be almost impossible to remove the plaster from the bowl. Another easy way is to scoop the surplus plaster out of the bowl while it is still soft with the fingers, leaving the bowl clean for future use when needed; in the place of the salt, sulphate of potash may be used to make the plaster set more quickly if preferred, but will give no better results than the salt, and is much more expensive; hot water also facilitates the rapid hardening of the plaster.

SHEETING BEES-WAX.

In making almost any preliminary and face pattern, sheet wax may be used to advantage either in part or as the whole over other materials. There are various ways of making the wax into sheets of the thickness required, amongst which the following methods may be mentioned as being the most practical. When the wax is sheeted in large quantities it is rolled to the required thickness in a machine where the rollers are heated to soften the wax and moistened with soapy water to prevent the wax from adhering to the rollers. The best method for general adoption where it is desired to have equally close results with an inexpensive outfit, and which is the only reliable one that I know of that could be applied by every one desirous of doing so for this or any other purpose, is as follows: Get a large deep saucepan, such as is used in every household (the depth of the pan is more of an object than the diameter, which should be as small as consistent for the purpose intended), fill it about three-quarters full of water (hot or cold), put into the water about one-half or one pound of bees-wax, and boil slowly until the wax is melted; the pan and contents must be watched very closely or the wax will boil over, and it will all be wasted. As soon as the wax is melted lift the pan off the fire and let it stand a few moments until it has cooled off somewhat, when if there is no foam or air bubbles on top of the wax it is ready for dipping; if there are any air bubbles they are easily dispersed by working them to the edge of the pan with the plaster knife; next take a bottle of any size (a large soda-water bottle is as good as any), fill it nearly full of cold water (the colder the better), take the bottle, wet it on the out side and the bottom with soapy water, or with the fingers, by first dipping them in water, then rubbing them on a piece of soap and then around the outside and bottom of the bottle to prevent the wax from sticking to the bottle; now dip the bottle into the center of the pan (not too quickly) as far as possible,

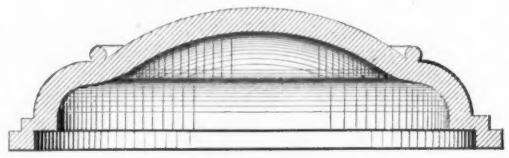


Fig. 18.

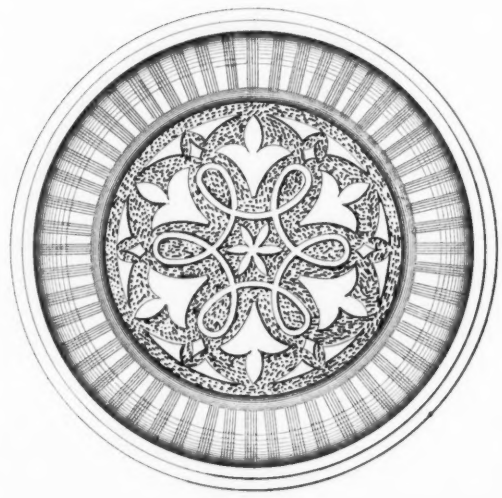


Fig. 17.

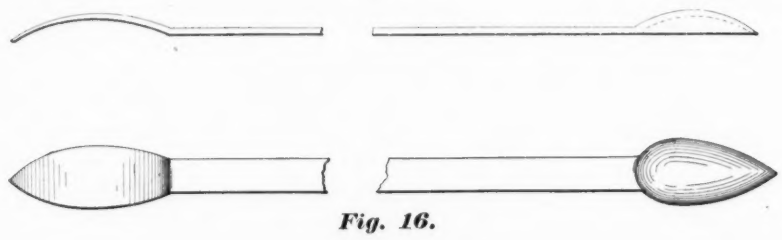


Fig. 16.

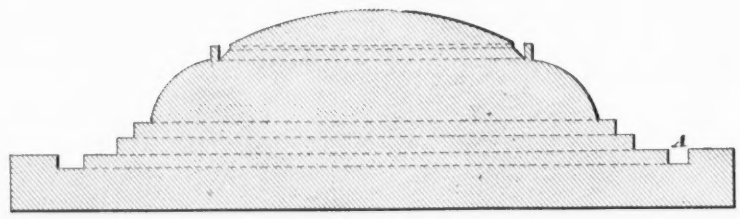


Fig. 19.

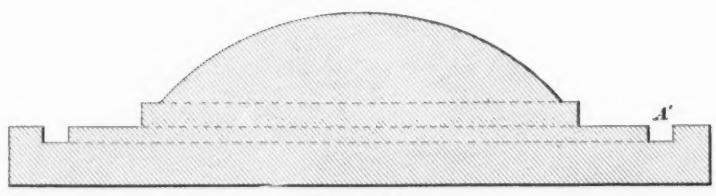


Fig. 20.

RUBBER PATTERNS.

then withdraw at about the same rate, hold it above the pan for a few seconds until the wax that has adhered to the bottle has commenced to set a little, which may be somewhat facilitated by shaking the bottle, repeat the operation of dipping, etc., until the wax is of the thickness desired; the wax on the bottle is then cooled off by dipping the bottle into a pail of cold water or elsewhere, cut off a ring of wax around the bottom of the bottle, draw the knife through the wax on one side of the bottle to part or separate it, and it can be pulled away from the bottle and straightened out. This method is very little known, and is therefore not often used. A slab of marble or a piece of thick sheet glass is generally used for the purpose of dipping the wax in place of the bottle, but the result is far from being satisfactory with either; about three dips of the bottle will generally average about $\frac{1}{32}''$, but this may vary somewhat, according to the temperature of the wax and the water in the bottle. When it is necessary to have the wax sheeted say $\frac{1}{8}''$ or thicker, it will be found better to sheet the wax as follows: Melt the wax in the pan without using the water (as above), then pour the wax into a shallow tin dish (a tin pie-dish will do) until it is about the thickness desired, then before the wax has time to cool place the dish on a perfectly level surface, or place it on water so that the dish will float, when if the wax is not too cool it will be found to be of an even thickness throughout.

As the bees-wax of commerce is seldom adapted to the purpose of sheeting, or, in fact, of being manipulated in any way without the addition of some other ingredient, to make it more tough and better adapted to this purpose a little resin of ordinary grade may be added, and to reduce the hardness and make it more flexible a little paraffine (a small piece of a candle will do). Venetian turpentine is recommended as being superior to both, but as yet I have had no occasion to use it. Any thickness of wax can be made by placing one sheet upon another, or by doubling them.

METAL MOLDS.

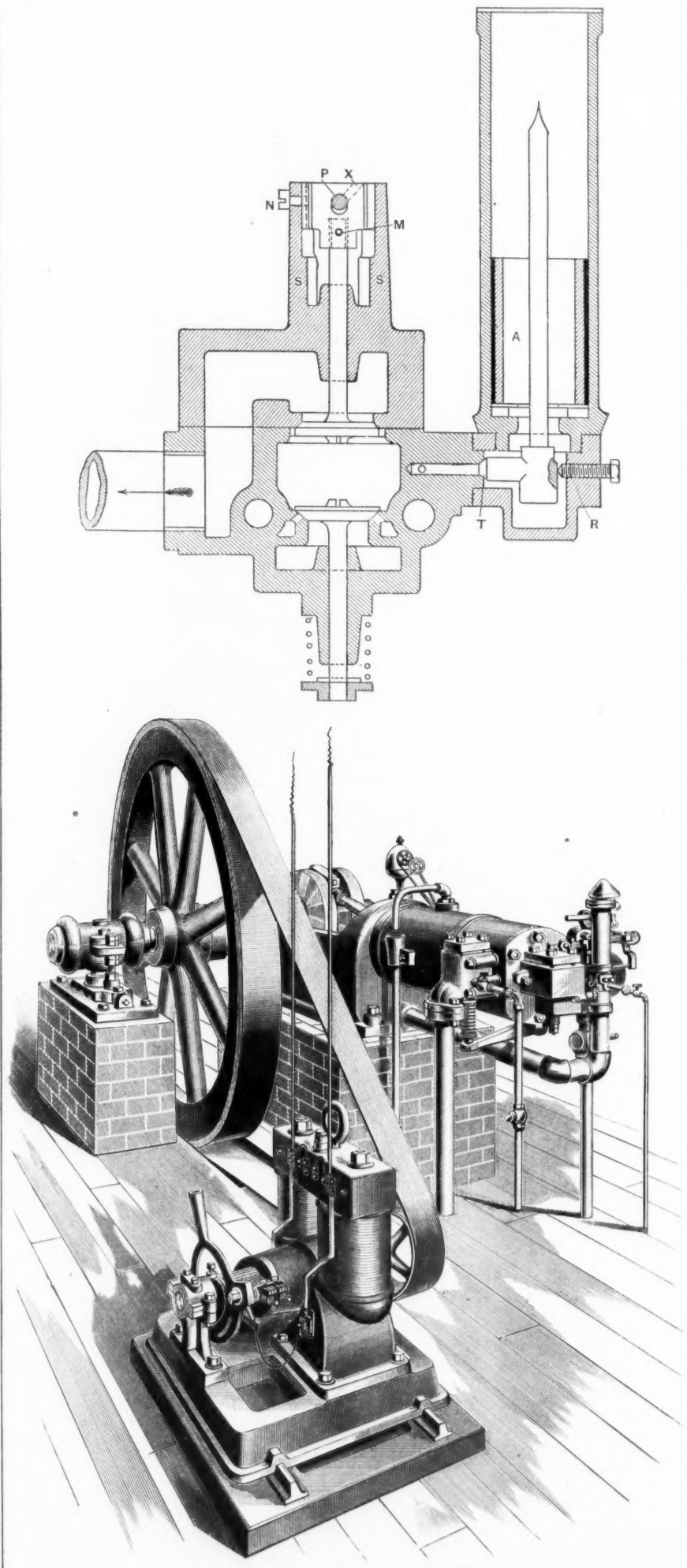
For making a large number of patterns in rubber, for attaching to cards or to be used singly, a metal mold or die can be made in preference to making a preliminary pattern, and can be used to make as many patterns as desired. The metal molds can be made of white metal, brass, composition, cast-iron, or steel as desired. The metal molds are to be finished as nicely as possible, and are to be so arranged as to take the place of the preliminary pattern, plaster molds and flasks. The metal mold can be made either with or without having a preliminary pattern (in most cases) of the article, for making which the subsequent patterns are to be used; but there are many cases in which it would be cheaper to first make a preliminary pattern and afterwards make the molds from that. In making a metal mold for the duplication of patterns in rubber, it must be so arranged that it can be easily separated after the patterns have been made and vulcanized therein: it will be found rather a difficult matter to take the patterns out of the mold unless special provisions have been made for doing it, which can be done in most instances by having a set-screw tapped into the mold from the outside inwards at the most desirable point, the blank point of which is made to fit closely into the hole made for it in the mold, and which is to form a part of the mold itself; it will be plainly seen that on screwing the set-screw into the mold the pattern will be pressed outwards. Another way is to fit a round blank plug tightly into the mold surface, and which is to form a part of the mold itself; the set-screw is then fitted behind this plug, and on being tightened up presses the plug forward and the pattern with it; when the pattern has been removed the set screw is to be loosened and the plug pressed back to its proper position. I will give a few examples of making the more difficult forms of patterns and the methods of making the molds for the same. Figs. 17 and 18 show external and sectional views of the outer part or portion of a door-knob pattern.

I will give two or more methods of making or constructing that part of the mold which is to form the face or external surface of the pattern. A plaster block is first poured or run approximating in size the half of the mold for which it is to be used (as it is presumed for the sake of illustration that there is no preliminary pattern from which an impression can be taken in this instance), but large enough to finish to the full size of the half mold mentioned. Allow it to harden; as the shape of the desired half mold is such that it can be turned, or rather the blank for the same can be turned in the lathe. It is an easy matter to do so—first putting the plaster block in the lathe chuck, or fastening it on the face-plate of the lathe with plaster or glue, or otherwise as preferred; it may then be turned to the desired shape or form, using the same tools as are used for wood-turning. Should the plaster be too hard to turn very readily, it may be moistened by holding a wet sponge or anything else against the plaster block, when it will be found to turn very easily. In cases of this kind no allowance need be made for finishing, unless it is necessary to have the pattern of an exact size, when the usual allowance for shrinkage of the metal in which the mold is to be subsequently cast is made, less the estimated amount for finishing the mold, but no allowance whatever is to be made on the mold (metal) for shrinkage of the rubber patterns, as the rubber patterns made in metal molds will not shrink, and will need no finishing if the molds are properly finished. In this instance, as the design on the outer surface of the pattern can be more readily carved on a convexed than on a concaved surface, a face pattern can be used or made to better advantage than turning a blank for the half mold and carving the design on the interior of the same. The blank for the face pattern should therefore be made like Fig. 19, which shows sectional view of plaster blank ready for carving the design thereon (and also a grooved ring *A*, which serves to locate this half of the mold concentric with the other half of the mold). The design is then carved on the blank face where necessary, the same as though it had to be used as a pattern; when this is done, it is to be carefully shellaced (using alcoholic shellac) and laid aside to dry; when the shellac has dried, it may be shellaced a second time (though this is not always necessary), and again allowed to dry, after which it may be placed in water and allowed to soak for at least ten minutes. An impression of the face pattern may then be poured or taken in plaster, by first fixing a wall of paper or anything else around the face pattern, to confine the plaster within the necessary limits, and then

mixing enough plaster to pour the impression; the plaster being always wet when poured. A little plaster is first poured on the highest part of the face pattern (and in other cases on the highest part of whatever is being poured), the plaster is then made to flow or run to the lower parts as quickly as possible by taking the face pattern in the hand and jarring it repeatedly on the bench or elsewhere; a little more plaster is then added again on the highest part as before, and the jarring repeated, and so on until enough has been added. It should not take more than two minutes to pour an impression or cast of anything, and as many as from eight to twelve may be poured at the one mixing of the plaster, if that number are ready for pouring. Should the jarring mentioned above be omitted in pouring impressions, or too much plaster added at one time, the chances are that the impressions will be imperfect. Should the shape or form of an impression, face pattern or cast be such that they could not be separated by inserting the point of a knife-blade between them without the risk of damaging the impression, face pattern or cast, as the case may be, then the part that has been poured or run must be carefully cut away, until the shellaced surface can be seen through the plaster; this cutting can in most cases be done in such manner that the parts can be lifted away in large pieces, leaving the part it is desired to save or preserve intact. The guide groove *A*, Fig. 19, has now become a ring on the impression, and so a guide groove must be made in the opposite half of the mold for this ring to fit into. When the impression has been opened, the outside of the same may be trimmed off or cut away until it is of the shape and thickness it is desired the mold should be. It can then be carefully shellaced and used as a pattern, from which a metal duplicate is to be cast, which in turn is, after being fitted and finished, to be used as the mold in which the rubber patterns are to be made.

The mold for the inner portions of the "door-knob pattern" can then be turned as per Fig. 20, with a guide groove *A'* for the guide ring *A* (Fig. 19) to fit into, as mentioned above. It may then be shellaced, and a duplicate cast in metal of this also. The two halves of the mold are, after being finished, placed together and three ¼" bolt holes drilled at as many convenient points near the outer margin of the mold, for bolting the same together; after the rubber has been packed therein, the mold is then ready for use.

The blank and face patterns can, if preferred, be made of wood or other materials, and an impression taken of the same as described above, which is to be used as a pattern, from which a metal duplicate mold is to be cast, or when the inner half of the mold pattern, Fig. 20, has been turned, the preliminary pattern (proper) can be formed or built up on that with wax, by taking a sheet or sheets of wax, warming the same and pressing it closely down upon the mold pattern and tacking it there sticking it to the mold pattern by warming the spatula and melting the wax around the edges in such manner as to cause the wax to adhere closely to the surface of whatever it is desired to tack it too, without making any material change in the same; it may also be tacked by placing a little wax in the spoon of the spatula, melting it and then flowing it around the edges of the wax it is desired to tack. It can then be turned or otherwise formed like the plaster blank (Fig. 19), the inner half of the mold pattern, or that portion of the same that is exposed forming the base; the design can then be carved on the wax pattern in the same manner as for the plaster blank. It is then ready to have an impression poured or taken of it the same as described above for the plaster blank (Fig. 19), which is also to be used as a pattern, from which a metal duplicate (half) mold is to be made, as in the former case, except that, in this instance, the wax pattern and the base or that portion of the inner half of the mold pattern which is exposed is not to be shellaced; nothing need be done to the wax patterns except to wet the outer surface just before pouring the impression, and the plaster base can receive a coating of soapy water in place of the shellac; this must also be done just before the impression is poured. When an impression or cast has been poured or run with plaster, an appreciable amount of heat can generally be observed during the process (chemical) of the setting or hardening of the same; this heat is usually sufficient to soften the wax enough to allow it to separate when the impression has been poured, and has become hard enough to be opened; it can be readily separated if taken just at the point where the heat has softened the wax, but in case no heat has been generated, then it is better to warm the impression or mold a little (enough to soften the wax, but not to melt it), and then to separate the impression and inner mold pattern by inserting the blade of a knife between the two; for in this case, as the wax pattern was built up or formed upon the inner half mold pattern, it is obvious that neither the impression or half mold pattern can be cut away, as it is necessary to preserve both, and therefore they must be separated, as mentioned above, by inserting the blade of a jackknife between the opposing surfaces of the two, and gently prying them apart as the judgment may suggest. The wax can then be picked out of the impression and off the mold, and what cannot be easily picked away from either, can be scalded off with boiling water poured out of a teakettle, or a small hose could be utilized from the boiler, if convenient. When the wax has been removed the impression which is now the outer surface mold pattern and the inner surface mold pattern are to be shellaced and used as the mold patterns from which the metal molds are to be cast, as explained above for Figs. 19 and 20.



IMPROVED "OTTO" GAS ENGINE.

A New "Otto" Gas Engine.

The illustrations on this page give a perspective view and some details of a new gas engine which has recently been brought out by the Otto Gas Engine Works, of Philadelphia, Pa.

While the engine is, of course, adapted to general service, such as gas engines are usually employed for, it is especially designed to meet the requirements of electric lighting service, being speeded high and supplied with a fly-wheel and governor, which insure sufficiently steady turning to make it entirely satisfactory for this purpose. Our engraving shows the engine driving a dynamo for incandescent lighting, the crank-shaft being supported by a substantial outboard bearing.

A marked tendency is noticeable to-day among gas-engine builders towards the use of a hot tube for ignition purposes and towards higher speeds. Especially is this the case in England and in this country, while in Germany, where there are no less than sixty gas-engine building firms at this time, the ignition by slide valve and a live flame is still very common. The merits of this device consist in a very accurate timing of all the functions of gas and air-mixing admission as well as of the ignition which are all intrusted to it, and with proper care for lubrication it is a remarkably reliable and wonderfully simple device, which has in no slight degree contributed to the general adoption and the reputation which gas engines enjoy to-day. On the other hand, the gas engine slide has to take also a large portion of the blame, which is sometimes put upon gas engines, as poor lubrication and lack of cleaning occasions rapid cutting of the slide. For this reason slide-valve engines have been furnished in this market by the Otto Gas Engine Works, with a spare slide and a spare plate and cover against which it works, thereby avoiding the necessity for interruption in service by a cut slide. On large gas engines it seems, however, that this company have had the hot tube ignition in use many years, and of late they have fitted it to their new designs of high-speed engines of medium size. The engine illustrated is one of this description, being of 16 actual horse power, and arranged to run at 250 revolutions with sufficient regularity for driving an incandescent dynamo direct, with perfect results for steadiness of lights.

The sectional cut shows the manner of fastening the tube in position and quickly replacing it when burnt out, by another one. The tube is screwed into a small steel block, which has a taper end T fitting against a ground seat, and the block is pressed against this seat by means of a small bolt *R*. By loosening the bolt the tube holder and tube drop out, and another holder fitted with a fresh tube can be inserted without delay. The average life of an iron tube may be taken at thirty hours' work, though some are good for much longer time when care is taken that they are not heated more than needed. Into this tube, kept at a bright red heat, the mixture in the cylinder is allowed to rush by the opening of a small valve, and thus the entire charge is fired at such time as to give the maximum pressure near the beginning of the stroke. This valve or timing device is not used on small engines of one and two horse-power, but is essential on large engines not only in order to get the most economical results, but to guard against accidents when starting, as when turning fly-wheel slowly, the mixture may reach the hot part of tube before the end of stroke is made and throw the piston and fly-wheel back, and thus injure the operator. The "Otto" Gas Engine Works fit the same type of engine as illustrated, also with a very simple electric igniter, which has been found to be very reli-

able and efficient, and where a gas engine is used for electric lighting, such a method seems much more suited, as the electricity for the spark can then be taken from a small storage battery kept charged by the dynamo. This igniter dispenses not only with the renewal of tubes, but with any outside fire about the engine, and for this reason the "Otto" Gas Engine Works use the electrical igniter mainly on their gasoline engines. With this extremely cheap fuel—drawn as fluid into the engine cylinder, where it is atomized by the inflowing air—most economical results can be obtained wherever power is needed and no gas is obtainable, though many gasoline engines have been placed in suburbs and cities in establishments where no objection to storage of gasoline by insurance companies was raised.

Parallel Wedge.

The accompanying illustration shows an improved form of wedge for use on planers, shapers, drill-presses, etc., where it is desired to support work level with the platen and hold it securely without springing. It consists essentially of a block, which is provided with an inclined groove in which is placed a steel wedge, with provision for clamping the latter by a bolt which passes through the block just below the wedge and clamps it by a washer in such a way as to avoid bruising or marring it. Every machinist will at once see the utility of a set of such parallel wedges. They are made in three sizes from $\frac{3}{4}''$ to $1''$ in height; from $1\frac{1}{16}''$ to $1\frac{1}{2}''$, and from $2''$ to $2\frac{3}{4}''$, by the Hayes Tool Company, 41 Cross street, Portland, Me.

A New Friction Clutch.

The accompanying illustration represents a new friction clutch, which has been designed especially for machine tool countershafts, which require frequent reversal without jar or undue wear of friction surfaces.

By reference to the cut it will be seen that the friction proper consists of a spring ring, which is caused to expand by the drawing in of a taper bolt, this bolt being operated by the usual finger and sliding cone; it will be seen that the friction ring has no direct connection with the hub, being connected thereto by two curved arms, which extend as far as possible to the opposite side of hub. This feature greatly increases the elasticity of the ring, and allows it to fill in all directions, giving a perfect bearing. Double provision is made for taking up all the wear, by means of the usual adjusting screw with set nut on outer end of finger, and also by screwing the taper bolt into the nut, which is pivoted to inner end of finger. This allows of a readjustment, should the clutch wear sufficiently to use the full length of outer screw, by simply screwing down the taper bolt and returning outer screw to its original position.

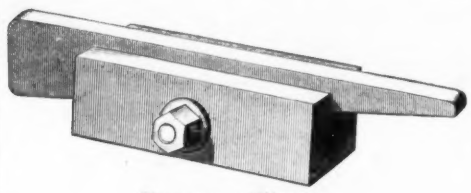
The pulleys are made with long and ample bearings; the inner hub extending inside the friction beyond the face of the pulley, and is provided with an efficient self-oiling device.

These clutches have withstood the most severe usage, and have proven especially serviceable with high speeds and heavy loads, giving a quick and positive reversal with a smooth and easy motion, which latter feature is most important in countershafts, which are constantly reversed. These friction clutches are made in three sizes, and will hereafter accompany all standard machines having friction counters; built by the manufacturers, the Garvin Machine Company, Laight and Canal streets, New York City.

Mr. Walter G. Chase, of the Mason Regulator Company, Boston, and Mr. Chas. H. Barnes, of the Boston & Albany R. R., sailed for Europe on the 8th, where they will remain for about three months, partly to enjoy themselves, and partly to look after railroad matters, and the business of the Mason Regulator Company in foreign countries.

Vertical Milling Machine.

In our issue of October 23, 1890, we illustrated a vertical milling machine, in which the distinguishing feature was a spindle, capable of running at a very high speed, to



PARALLEL WEDGE.

adapt the machine to the use of very small cutters on soft metals, where a high speed is necessary to efficiency.

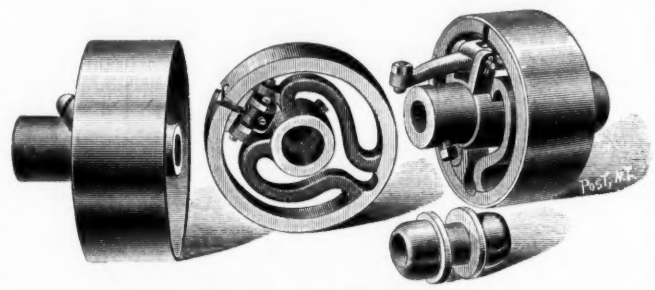
The present machine is the latest improvement by the same builder, and, as will be seen, retains the distinctive features of its prototype, while adding others tending to widen its scope and add to the convenience of operating.

The belt thrust in this machine is taken upon a bearing which rests upon rollers, reducing the friction to an inconsiderable amount, while at the same time it relieves the spindle of all side pull caused by the belt.

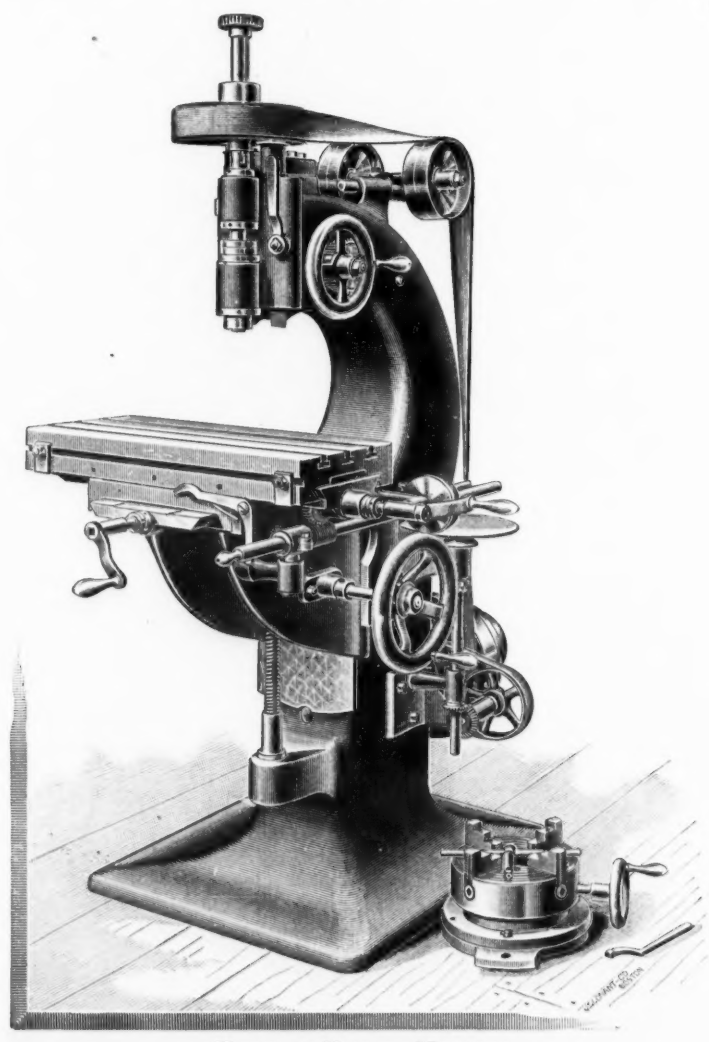
The spindle is mounted in a saddle, which is moved up or down by hand wheel shown at the right, and can be clamped by the lever seen in front. Milling tools are held in place by a threaded rod, which passes through the hollow spindle, making it easy to secure or remove them. The spindle is made of tool steel, hardened and ground to insure accuracy.

The platen has an automatic feed, which is automatically released at any desired point when moving in either direction, and the different rates of feed are obtained by means of a friction disk and roll, which latter can be placed any desired distance from the center either side, for feeding at any desired rate in either direction. Adjustable stop gauges are provided for all movements for convenience in duplicating work. The lateral feed of table is 16"; cross-feed (in and out from the column) 11"; vertical adjustment of knee, $15\frac{1}{2}''$.

There is also furnished when desired the rotary attachment shown on the floor at the side of the machine, this being provided with a 9" chuck, in which work may be secured and rotated by means of a worm and hand wheel as shown. This, of course, will be found very useful for a large class of work, and any desired fixture may be fastened to the platen, T slots being provided for that purpose. Special pains have been taken to have all hand-wheels placed in the most convenient position for the operator, so that the machine may be handled with the greatest possible facility. The greatest distance from the platen to the spindle is $15\frac{3}{4}''$, and the machine weighs complete ready for boxing 1,500 pounds It is built by The John Becker Manufacturing Company, 157 Pearl Street, Fitchburg, Mass.



FRICTION CLUTCH PULLEY.



VERTICAL MILLING MACHINE.

On the Development of the Inventive Capacity by the Solution of Constructive Problems.

BY LEICESTER ALLEN.

A considerable number of responses have been made to the new problem enunciated in the AMERICAN MACHINIST of February 11. Before considering them, I think it proper to notice a communication from Mr. A. F. Mowry, of Holyoke, Mass., which contains some kindly criticisms. Mr. Mowry writes as follows:

"In my last copy of AMERICAN MACHINIST, Feb. 11, 1892, I notice you illustrate a solution proposed by W. P. Tarbell, of Milford, N. H., and give reasons for terming his moving device a 'gear wheel' or 'cam,

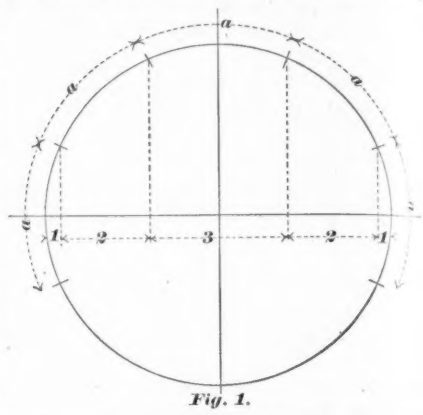


Fig. 1.

or analogous thereto, and below you ask 'Is it or is it not a mutilated gear wheel?'

"Then later you refer to my 'tacitly admitting the validity of the position I took, that Mr. Powers' solution included a crank,' etc., but state that I 'immediately perceive an analogy between the disk with a pin in its face to a rack and pinion.'

"Now, I have no copy of my letter, and therefore cannot see whether I wrote just as you put it, but as I remember it, I think I spoke of the combination as '*a rack and pinion, or perhaps more correctly, crown pinion,*' using the word *crown* as applied to gears having teeth on the side of the rim.

"However, as you say, it is a rather nice point to distinguish the limitations between a crank, gear and cam, and as I am afraid of getting myself into deep water, will not give any definition, although now that you bring the subject up, I should like to give my views and to hear others, but outside of the present discussion.

"Now I am going to ask for an explanation of what I think to be an erroneous statement in the latter part of your remark regarding the fact of my solutions fulfilling the requirements, etc.

"To start with, you say in the original question (date of Oct. 8, 1891), restriction 6, 'The part or parts which directly move the slide *a* must have a uniform motion.'

"I do not see any other remark bearing upon the act of motion except the general specification in the paragraph describing the kind of motion required.

"Now in the copy of Dec. 3, 1891, in the discussion regarding Mr. F. W. Clough's criticism of Mr. Powers' solution, in issue of Nov. 5, 1891, you say (in upper part of last column), 'Neither is the criticism, that the slide is not moved uniformly by this movement, valid, because nowhere in the restrictions was it required that the *slide itself* should move uniformly.'

"Then you quote restriction 6.

"Now then, what I am coming to is your criticism of my movement in the last issue (Feb. 11, 1892,) where you say, 'but, as shown in his sketches, it appears to me that they would not cause the slide to move uniformly between the periods of rest, *and this was a requirement of the problem.*'

"How do you reconcile this with your former statement given in answer to Mr. Clough's letter, and with the original specifications? Now, as a matter of fact, one of the designs *will* give a uniform motion (the one in which I use the belt), and the other, strictly speaking, will not, neither will any combination which you have illustrated, which combines a revolving disk, etc., which have a pin or lug imparting motion to the slide by striking against a lug or in a slot, for the simple reason that a pin revolving in a circle and giving motion to a slide cannot (if revolving at a uniform speed) give a uniform motion to a piece sliding in a straight line.

"It is the old argument of a crank-pin and steam piston as I look at it. See diagram to illustrate my point.

"Spaces *a a a a a*, Fig. 1, are equal, but the motion which they would give to a sliding part would be about like 1, 2, 3, 2, 1, which is not a uniform motion, if by that term you mean a motion of continuous

velocity, and that is why I do not claim a uniform motion for sketch, which includes the pin and slotted slide, which design I am inclined to think resembles a 'crank and slotted crosshead' modified, although you do not apparently object to it for that reason.

"In regard to your other problems, I have not thought about them any, but shall take time to see what I can devise, as I am quite interested in the matter and think it a very good scheme."

I have to confess frankly my error pointed out by Mr. Mowry in my article of February 11. I think I intended to say, in reference to his solutions, that "it appears to me that they would not cause the part that directly moves the slide to move uniformly," and that by a slip of attention, the words "*the part that directly* moves" were omitted. However, as his correspondence and sketches have been returned to the editor of the AMERICAN MACHINIST, I am unable to check this supposition, and I may have misunderstood Mr. Mowry's sketches. If so, I offer, and hope he will accept my sincere apology. I repeat that I do not presume exemption from mistakes above others. From the materials supplied for the solution, I try to do the best I can.

Mr. W. P. Tarbell also writes as follows:

"I am sorry that there is any misapprehension shown regarding my device, as submitted by model to you, by your description and drawing in the AMERICAN MACHINIST for Feb. 11. The drawing sent you at first gave you an impression that two actuating teeth were formed on the rotating part, whereas only one was intended; the second one shown on the *sketch* was made in open lines to represent the same in different position relatively to the slide. This point was not made so clear as it should have been at that time. After seeing the impression it made, I sent you the model with some explanation, but the first impression remained with you, as you have divided the rotating part into something approaching gear teeth in shape.

"The front or straight part of the rotating (what is it?) *alone* operates to move the slide, the rest of it, contained within the arc, can be chopped into gear teeth if wanted for ornament, but, of course, would have no other use. The arc alone, as has been said, operates to hold the slide during its point of rest, when it extends backward, just clearing one stop as the next one is engaged, but, of course, anything extending backward beyond this would prevent the slide from moving at all.

"So the point to be decided then is, What is the mechanical movement to be called that works the slide? I trust this explanation may not be considered as out of place."

I must also offer to Mr. Tarbell an apology for the misapprehension pointed out by him, which, I perceive, is my own fault, arising from not more carefully scrutinizing together his first and second communication.

Mr. John I. Slocomb, of Providence, R. I., contributes in Fig. 2 still another solution to my first problem in issue of October 8, which is correct in principle, and develops a new feature, namely, the extension *B C* of the chain links, by which a very firm engagement of the lugs *E* on the slide (not shown) can be made. The parts are: *A A'*, sprocket wheels; *B*, link having extension *C*; *D D'*, bell crank lever pivoted to lugs *E E'*, the lug *E* being attached to the upper part of the slide (not shown), and *E'* being attached to the lower part. The toe of the lever *D* is notched so as to hook on the extension of the link. As the slide is moved, this toe is depressed, as shown in the dotted outline, and, at the time it is disengaged, the upper extremity of the bell-crank lever rests against the stop-pin *H*. The spring *G* is to bring the lever again into position for a new engagement. This part is rather vaguely shown, but the general working of the device can be understood readily.

Mr. Slocomb also sends a solution of the problem given in issue of February 11, which is entirely correct. It is shown in Fig. 3. A second sectional view forwarded by Mr. Slocomb is hardly necessary to the understanding of his solution, and hence is omitted. *A* is a plate in which is formed a triangular opening. Fitted to the angles of this opening is a triangular block *D*, to which is rigidly attached the needle *I*, and to which also the sliding block *E* is pivoted. On a central shaft *H* turns the cross-piece *C* In this cross-piece is a guideway for the sliding block *E*, which is held firmly pressed against the triangular block *D* by a coiled spring *G*. The geometrical centers of the needle is continuous, that is to say, the changes of direction of the block *D* are theoretically instantaneous, and there is no pause of definite duration anywhere in the circuit. The direction of rotation is reversible.

Nevertheless, the mechanism is more complicated than absolutely necessary, as will be seen by some other solutions to follow, some of which are very interesting, not only as indicating the different ways differently constituted minds approach the same subject, but as also exhibiting a reach of

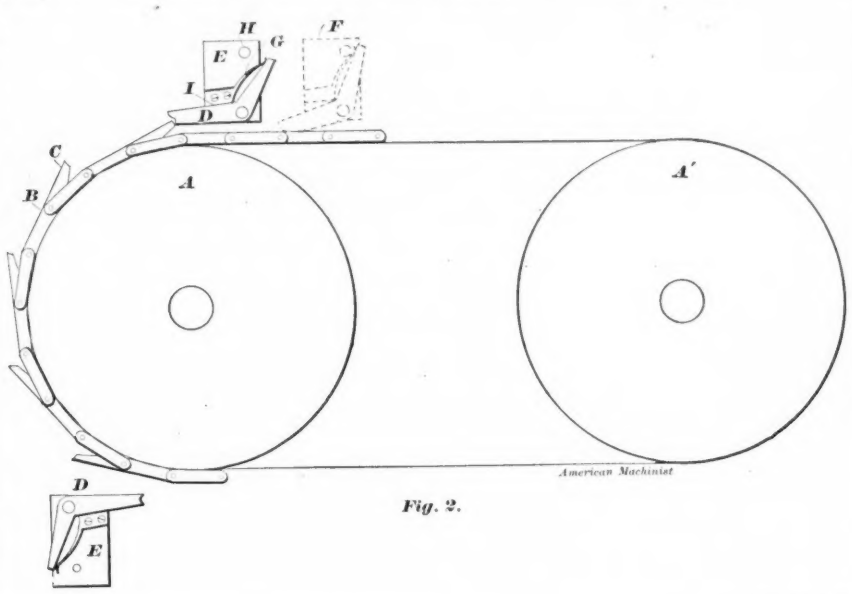


Fig. 2.

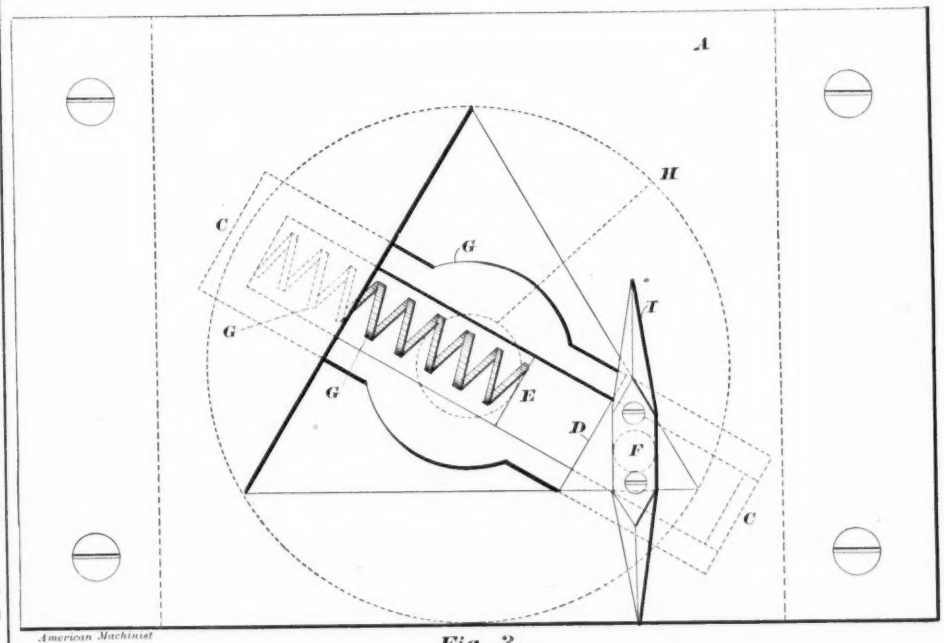


Fig. 3.

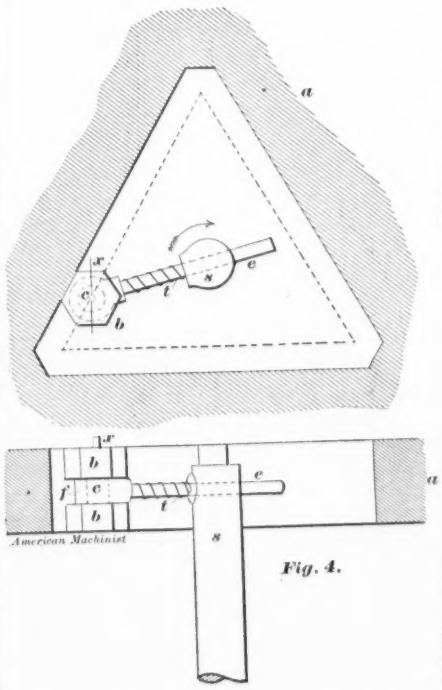


Fig. 4.

shaft *H* and the triangular opening coincide, and the cross piece *C* rotates horizontally back of the plate *A*.

It will be seen that this solution meets all the requirements of the problem. The moving parts—exclusive of the needle—are the cross-piece, the spring, the slide *E* and the triangular block *D*. The motion of the

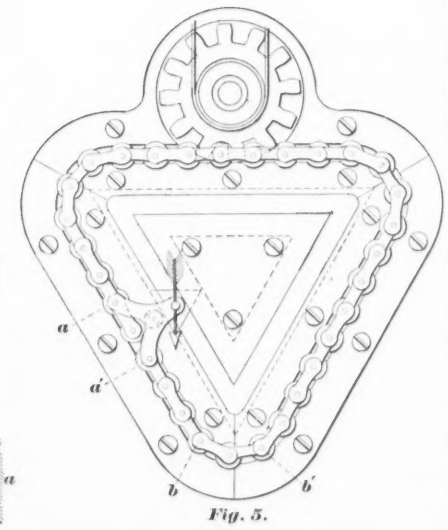


Fig. 5.

thought considerably beyond what the problem actually demanded for its mere solution.

Here is one, Fig. 4, from Mr. O. P. Hood, Professor of Mechanics and Engineering in the Kansas State Agricultural College. Professor Hood writes as follows:

"I have derived quite a little pleasure from the problems you propose in the AMERICAN MACHINIST and the answers thereto. I hope they will be continued. I inclose what I think is one solution of your last proposition.

"In a block (*a*) a triangular hole is made whose sides shall be finished as sliding surfaces for a hexagonal block (*b*) which carries in the center of its upper face the needle support (*x*) The block (*b*) is formed of an upper and lower hexagonal head connected by a cylindrical part (*c*), which finds a bearing in the eye on the end of sliding rod (*e*).

"The axis of shaft (*s*) coincides with the center of the triangular hole. Transversely, through a diameter of the shaft a bearing is made for sliding rod (*e*). A spring (*t*) always keeps block (*b*) against the sliding surfaces as shaft (*s*) revolves. The drawing plan and section explain fully I think. This would be impracticable except for slow speed, of course."

The principle in this solution is fundamentally the same as in the solution supplied by Mr. Slocomb. It introduces the idea of truncated angles, probably to avoid the more difficult fitting of the acute angles in the triangular opening; and possibly the idea was also entertained that the sharp angles of the sliding block would not be as durable as the truncated angles. This idea could be carried out with only a slight truncation of angles, having a more ample bearing surface for the sliding block that carries the needle. Although the solution entirely meets the requirements, I should think a compromise between his movement and that of Mr. Slocomb, made by slightly truncating the angles of the triangular block, the other features remaining, as shown by Mr. Slocomb, would be an improvement upon either solution as presented.

In order to point out clearly its faults, I show in Fig. 5 an attempted solution presented in a very neat drawing by Mr. J. K. Love, of Waterbury, Conn. In this a sprocket wheel is used to drive an endless chain that is intended to move a triangular block carrying the needle. The connection between the triangular block and the chain at the points *a a'*, so far as shown or explained by Mr. Love, being rigid, it will be seen that they cannot take the positions at *b b'*, which would be necessary in order to change the direction of movement at the angle. This obstruction would happen at each of the other angles. Moreover, with this connection (even supposing it could work), there would be a definite pause in the motion of the needle at each angle of its course during the period that the connecting piece describes an arc of sixty degrees around the center of the needle support.

The latter point has been overlooked in several other solutions, which, together with some correct ones introducing other principles, are reserved for future discussion.

In conclusion, I feel impelled to express my great satisfaction with the educational effect these problems are obviously producing—the power to think clearly, and the ability to express thought with precision, are manifestly cultivated in these exercises as well as the inventive faculties.

LETTERS FROM PRACTICAL MEN.

Placing Globe Valves.

Editor American Machinist:

In looking over the Question and Answer column in the last issue of the AMERICAN MACHINIST, I noticed in Question No. 71 that O. S., of Rockwood, Tenn., asks for information about putting globe valves in steam pipes connecting engine to boiler. He asks, "If it is correct to put a globe valve in steam pipe with the pressure on top of valve?" and you answer him "that it is correct."

Now, if you will allow me, I think that I can offer some very good reasons why it is *not* "correct." In the first place, if said engine is a stationary one, and the globe valve in pipe be put in with pressure on top of valve, and the valve become loose from the stem (which they too often do), the pressure would force it hard down on the seat, and no matter what depended on the power a complete shut-down would result, and perhaps something more serious, as in case of

elevators, hoisting engines, etc., where, if the pressure had been on the bottom of the valve, it is possible to run until such time as repairs can be made.

It is customary to put a globe valve next to the dome in the steam pipe connecting engine to boiler on boats, that is, on the smaller boats, such as we have on our lakes for tugs, yachts, etc. Now I think if that valve was put on with the pressure *on top*, and should work loose from the stem and drop on the seat as we were trying to make a landing, somebody *would get wet*. Now in case of steam-heating plants, if the valves were put in with the pressure on top of the valve, and the packing around the stem should blow out, there is no way it can be repacked except the steam be shut off at the head of line or branch of line. Again, it is often necessary to drain a valve, that is, to put in a pet cock to drain it off in cold weather, which cannot very well be done from the top of a globe valve, especially the smaller ones. Hoping to hear from others on this same question, I remain yours, Clayton Stanton.

Editor American Machinist:

The question asked by O. S. in Question No. 71 has several sides to it. While you are undoubtedly right as to pressure being on top of valve and obviating all danger from the stripping of the thread, in addition to this the valve will tend to close tighter as the pressure forces it shut. However, it has several disadvantages, and like O. S., in all ordinary cases, I prefer the pressure underneath for several reasons. In the first place, it is not convenient to pack a valve stem with the pressure on the top of the valve; and secondly, in the case of a valve with a loose disk, which is usually held by a small check nut with a fine thread, there is much more liability of this check-nut thread being stripped than that of the valve stem. In fact, the cases of valve stems being stripped by the pressure of steam are exceedingly rare, and in small valve work at least may almost be neglected, although I approve of the utmost precaution in anything of the kind. Having the pressure on the top of the valve is the cause of many troubles with jet apparatus, from the disks or removable washers getting loose and closing the opening, often intermittingly, which makes a very puzzling case to diagnose when called out to see "what ails the thing, anyway."

For ordinary piping, such as we find around boiler-rooms, and for valves for use in connection with injectors and similar apparatus, the pressure under the valve will give the least trouble, and will, under ordinary circumstances, be considered safe.

To really appreciate this trouble of having the disk come loose, one must be called into a hot boiler-room, and be expected to find the trouble with an injector at a glance, and after being assured that the valves are all new and all right, be compelled to take down some of the fittings to discover that the disk or seat is loose.

Fred Herbert Colvin.

Placing a Cylinder Lubricator.

Editor American Machinist:

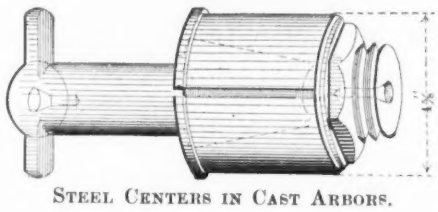
Upon which side of the steam pipe should the lubricator be placed?

It is not supposed that it will make any difference to the lubricator or its working which side of the pipe it occupies. But it does make a difference to the engineer, and the smooth working of his temper, to have the lubricator placed in the most conspicuous and convenient position possible, and that is the proper side of the steam pipe to put the lubricator.

But the question was prompted by an engineer having trouble with the unequal distribution of oil in a Corliss engine, the lubricator being tapped into the side of the steam pipe nearest one end of the engine, the oil running down the inside of the pipe, and the largest portion going to that end of the cylinder to the detriment of the opposite end. This can be noticed very readily when an engine is heavily loaded, the oil not having time to spread.

In overcoming this difficulty in my practice, I thread a half-inch pipe on one end, in length equal to half the diameter of the steam pipe plus the thickness of the pipe; screw this long threaded end into the steam pipe that the oil may be discharged into the center of the steam pipe, whereby the oil is bound to be equally distributed.

Connect the lubricator to the outer end of



Steel Centers in Cast Arbors.

this half-inch pipe with a brass sleeve, or, what might prove to be better, a half-inch gate valve; a globe valve will not do, and to use a malleable sleeve is to have a continual leaky joint. In using a half inch gate valve, leave the valve stem point down ward that the oil may not work out around the stem. S. A. Smith.

Steel Centers in Cast Arbors—Bevel Gears.

Editor American Machinist:

I note some remarks in your columns in regard to securing steel centers in cast-iron arbors. What for? No two metals wear better together under slow speeds, than cast-iron and hardened steel. I subjoin a sketch of an expanding arbor on which I had many hundreds of pieces turned, and never discovered any evidence of untruth in the work, although it passed through several operations after turning, which would have disclosed any errors of even small magnitude. This arbor was of ordinary expanding construction, with a tapering body, a split sleeve, and a flanged cast-iron nut, with a cast-iron wrench for the nut. The cost of the whole job for labor was an hour of my own time on the hand sketch, 3 hours pattern work, and 6 hours lathe work. I certainly never used a more satisfactory tool. The chief point is to drill the centers with a large drill, I used ¼-inch, and drill deep, and give a liberal countersink.

I should like to see bevel gear cutting with spur gear cutters *fully* discussed. I have done the job a great many times, always sizing the gear blank at the middle of the tooth correct diameter for spur cutter, and setting index spindle to angle of *bottom* of tooth. I am certain that there is useful knowledge on this point in possession of some of the readers of your paper.

Easy Way.

Hardening and Tempering Steel.

Editor American Machinist:

I have followed the interesting articles on hardening and tempering steel, but as yet have seen no mention of the use of cyanide of potassium. During an experience of twenty years I have had to do a large amount of hardening tools, drawing, drop and cutting dies, etc., and have had such good success since I began to use cyanide that I wonder that we hear nothing of it, or that more is not used.

It has often been said to me that articles heated in cyanide and hardened were only case-hardened. While such is the case with iron or machinery steel, many makers of brass goods, spoons and silverware can testify that dies stand as well or better when hardened by the use of cyanide as by any other method, and where fine figured or engraved dies are used I know of nothing that will insure such a perfect surface.

A short time since I was called upon to try and harden some steel castings, boxes 9″ long, 5″ wide, 4″ deep, ⅝″ thick, without top or bottom, on which the owner had exhausted his knowledge of hardening without success—although he had broken some. I had a cast-iron box made large enough to take the steel castings, cored in the middle to avoid using too much cyanide, and having a close fitting cover with a projection to handle by with tongs. In this box I brought the castings to a low red heat in a furnace built for the purpose over a common forge, with cyanide enough to cover when melted, quenched them in cold salt water; every one was hardened and every one was perfect. I don't know how deep the hardening extended; a smart blow with the pene of a hard hammer showed no indentation, and they were hard enough for the purpose for which they were used. In hardening long cutting dies for spoons, ladles, brass work, etc., I have followed the same method with success. I always try and have several to harden at once to save the waste of cyanide. Of course, they will spring sometimes, but can in drawing bring them back to their proper shape. To draw the temper, I have a deep pan of sheet-iron large enough to hold several dies; those which have sprung I clamp together so as to spring them back a little more than straight, put them into the pan and cover with lard oil, heat over a slow, even fire until the oil shows the proper temperature, 540° for most of my work. After cooling, they generally are straight, or so that the cross pene of a hard hammer will bring them there. I have often noticed that a piece sprung in hardening will straighten itself without clamps in drawing by this method. Care must be used in handling the hot cyanide that no water comes in contact with it. I always keep all tongs or hooks hot to insure dryness before touching the cyanide.

In hardening drop dies I have a bath of hot lead ready, so that immediately on taking the dies from the water I can draw the corners to prevent them from cracking or flying off, being careful not to let the temper draw in as far as the figure, leaving that as hard as possible. I have used cyanide in hardening many other articles, especially where a fine surface was required or where finishing or grinding after hardening was not practical or convenient. To obtain the best results, I think a box with a tight cover and cyanide enough to cover the article to be hardened is required. My experience leads me to think there is no secret to success in hardening or tempering, only a knowledge of the steel used, or selecting a grade of steel best adapted for the work in hand, proper heating and working under the hammer, careful annealing and careful heating to the lowest heat at which the piece will harden; or in other words, knowledge of the steel and work required of it, and good judgment in its manipulation. Cyanide.

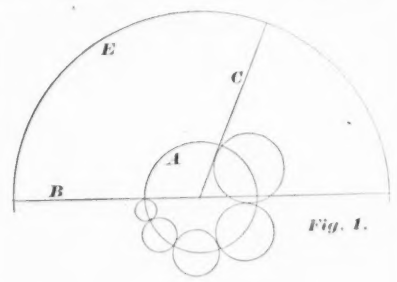


Fig. 1.

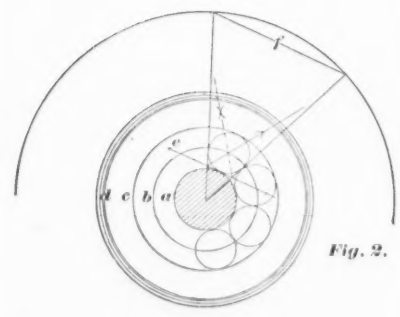


Fig. 2.

Dividing Circles.

Editor American Machinist:

In your issue of 10th of December, 1891, there appeared an article on "A Comprehensive Drill Pad," by Walter Gribben. In closing, he speaks of its being "a nice little problem" to so arrange the holes that an equal amount of metal shall be between each hole.

Not desiring to criticise any part of the above mentioned, I herewith send sketches, one of which gives a simple method by which such problems may be readily solved.

The circle *A*, Fig. 1, is to be the path of all the holes we wish to have in our plates. I have chosen five in this case, and by drawing them tangent to each other, as shown, gives us the position of the two radial lines *B* and *G*, by which we find the number of degrees left of the circle, which, divided by the number of holes (viz., five in this case), we have the amount of stock between each. If the line *B* is extended, as seen by the dotted line produced, it gives the diameter, and this latter may be preferred by some for dividing. Arc *E* is supposed to be drawn with six inches radius, to be used in connection with a table of chords, such as appeared in the American Machinist, October 31st, 1885, by G. B. Grant. I have used the above frequently, and can recommend it for accuracy and convenience.

Fig. 2 represents a part of a pulley sheave, with eight friction rollers, four of which are drawn. Let us assume the circle *a* to be size of center bolt or axis, the rollers to circumscribe the same. As we have chosen eight rollers, we must lay off one-eighth of three hundred and sixty degrees equal to forty-five, as shown by the radial lines. Next draw line *e* tangent to circle *a*, and parallel to chord *f*, which gives two angles; by bisecting them we have a point to describe a circle that shall touch the three given lines, and determine diameter of rollers; *b* gives path of centers, *c* size of hole to be bored in sheave, also guide for pattern-maker to core the same; *d* represents diameter of hub. Wm. Newton.

[The solution of the first problem may give results sufficiently accurate for many practical purposes, but it is not absolutely correct.—Ed]

The Size of Small Taps.

Editor American Machinist:

The letter in your last issue from Callender & Patterson regarding the absence of a tap wrench from the regular sets of taps and dies, reminds me of a little "kick" which I want to make against the practice of making the taps in such sets $\frac{1}{32}$″ full. It may be well enough in the large sizes, but in the smaller sizes, say ¼″ or ⅜″, I have found it very inconvenient, as an ordinary bolt or cap screw will almost fall through a hole tapped with them. Of course, there may be some good reason why they should be made that size, but up to date I have failed to see it. I prefer a ¼″ tap to be $\frac{8}{32}$″ instead of $\frac{9}{32}$″. Chas. W. Spicer.

New York.

Tap Wrenches with Sets of Taps.

Editor American Machinist:

We notice in your issue of March 3d, letter from Callender & Patterson, of Dayton, O., in regard to manufacturers of screw plates and dies not putting up tap wrenches with the plates. We have now manufactured the Billings patent drop forged screw plates in five sizes, cutting threads from $\frac{1}{16}$″ up to and including 2″.

We have always furnished a set of tap-holding dies to go in the box with each plate, which makes a very convenient tap wrench as well as screw plate. Parties will find our screw plate, dies and taps illustrated in our catalogue on pages 7, 8, 9 and 10. Very truly yours,

The Billings & Spencer Co.,
C. E. Billings, President.

A Chapter on the Sliding Surfaces in Machine Tools.

By Prof. John E. Sweet.

Where the standard machine tools as now built by so many of our reputable machine tool builders are employed on work not requiring any such degree of accuracy as the machines are capable of producing, then they will last a long time, and produce work perfectly satisfactory to their owners and the men employed to operate them. Where the machines used are capable of producing work so accurate that the errors produced by the operator are far greater than those produced by the machine, or where machines are used in the large tool-building concerns or large machine shops where the conditions are such that each machine selected for any certain job is exactly suited to it, these ma-

chines last for a long time and keep true, or near enough true to give long continued satisfaction.

There is no demand for a perfect planing machine where the workman has no conception of the fact that a $\frac{5}{8}$" bolt will spring a 2" cast-iron plate, or the table of an ordinary planing machine; where both the proprietor and workman are ignorant of the fact that a planing machine will warp on a settling foundation, or are indifferent to the consequences of moving a lot of castings from one side of the machine to the other, when both machine and iron are on the same wood floor.

In the use of a shafting lathe, when the work comes out $\frac{1}{8}$" crooked, and has to be straightened after finishing, and where the diameter is controlled by a device entirely independent of the straightness of the ways, when the ways are used from end to end, and the cross-slide not moved a dozen times a day; when it is not of the least consequence whether the live spindle is round, rigid or in line with the bed, it would be a poor tool indeed that would not give satisfaction, provided it had driving power and good tool-holders, nor is such a lathe liable to get much worse for the special purpose of turning shafting, no matter how many years it is kept going.

So, too, with a planing machine; if always kept on jobs exactly suited to their size, and not sprung out of shape by the workman, they will last a long time, and do as true work after years of use as at first.

Possibly there may be a few other machines that when used on exactly the right size job will keep true, and remain as satisfactory after a protracted use as at the commencement, and that without the refitting of the wearing surfaces; but they are few, that is, when the work produced is expected to maintain any degree of accuracy.

But the cases above enumerated are but a small proportion of the thousands of machine tools in use, and yet, how many of the machine tool designers ask themselves the question, "How long will this machine, which will do perfect work when new, last under constant use and still do perfect work?" In many cases, it would seem that it is simply following precedent without a thought. In others, it does not go beyond the simple idea of "suitable provisions for taking up wear," and if the question arises as to where the wear is to occur, and what will be the consequences of unequal wear, very little, if anything, has been done to anticipate it.

Making the ways on a planer-bed longer than the slides on the table is such a provision as I have referred to, and probably was used on the first machine built.

If machine tool builders would only make the table proof against springing, the ample wearing surfaces provided would enable the machines to do true work for a long time. But as they are built it is easy, and in fact, it can be said to be an every-day affair, where the bolting and clamping of the work springs the bed an amount greater than the thickness of the film of oil, and instead of a liberal wearing surface, half of it is lost.

The writer is of the opinion that, even with the success that might be obtained by a rigid table and present proportions, a still better result could be obtained by adding to the length of the ways and cutting away the surface, that is, give a better support to the overhang when making long cuts without interfering with uniform wear. By far the best form for the table is a rectangular box. It gives enormously more stiffness in all directions, costs less to make, and then the additional thickness allows for projecting over the upper surface to the full width between uprights, without interfering with the reversing dogs. See Fig. 1.

When flat ways are used, and the side-guiding is done by independent vertical surfaces different conditions obtain, and instead of the guide being longer than the slide it must be shorter. The reason for this will be understood by reference to Figs. 2 and 3.

Assume the guide *A* and slide *B* to be of the same relative length as the ways and slides of a planer, and the side pressure applied constantly at the one point in both directions, as shown by the arrows. It is plain to see by the dotted lines what the result of the wear would be, whether the machine was used on either short or long work. But if the proportions of the wearing surfaces be changed, as shown in Fig. 3, the long and short work would average up the wear, so as to maintain as long life for good work as the long ways in the vertical direction.

Among recently designed machine tools are those resembling planing machines, but with horizontal and vertical spindles for using cylindrical and traversing cutters. The strain to throw the tables out of position is far greater in these machines than in planing machines, and the plain V's, as shown in Fig. 1, are not sufficiently stable for heavy cuts. In such machines the plan usually adopted is that of the milling machine, and it is in these machines where the proper proportions are of the greatest importance, and yet are seldom studied. As

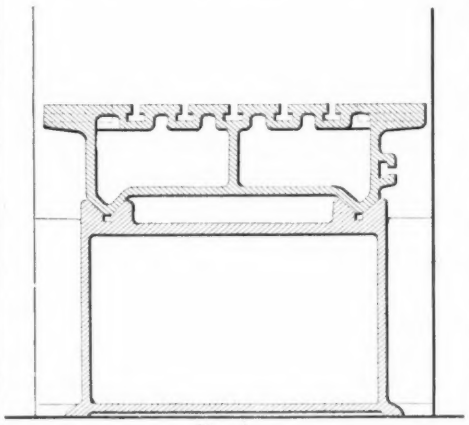


Fig. 1.

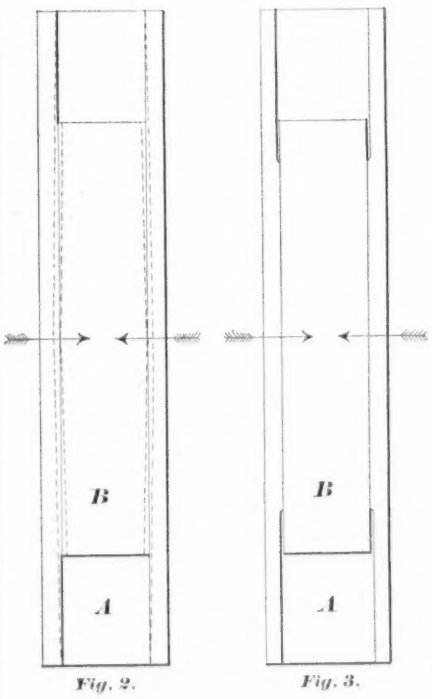


Fig. 2.

Fig. 3.

the wear is much greater than in planing machines, the necessity for truth and freedom from lost motion is of the greatest importance, and with gibbed guides unequal wear makes the slides tight at one point and loose at another. In this respect the ordinary milling machines, shaping machines and slotting machines are subjects open to improvement.

One milling machine known to the writer, which has been in daily use for twenty-five years, where the guide and slide are each thirty inches long, they have never been refitted, and are as true and as free from unequal wear as when made; while another of high repute, not over six or seven years old, has been refitted at least three times, and will require repeated refitting to the end of its life. One has wearing surfaces of equal length, and the other is a long slide working in a short guide.

There is one exception to the above harangue, and that is the Richards side planer. Not but what the tendency to wear is greater than in most other machines; not that there is better provision against unequal wear; but it is a place where side wear does no particular harm. However much there may be, or how much at the center and little at the ends, the tool will run practically in a straight line.

A shaping machine, with its ram a foot or so longer than its guide, is so universal that to see that foot cut off and dumped in the cupola would grate on the conscience of tool builders, though it would be a better place for it, but not as good as if one-half was cut off and the material used to piece out the guide. When new, as now built, they are all right, but when worn, which takes place almost wholly at the front end, and with the gibs set up, the ram cannot be forced out to its extra cut; the extra foot is of left-handed advantage. Poor work in an old machine comes more from unequal wear, that is, poorly fitting slides, than from a lack of length.

The usual arrangement of guides, slides and gibs, for managing the knee or milling machines, shapers and tools of that class, is as bad in proportion as the others, but the wear is small, and the greatest trouble or nuisance is from the cuttings and dirt. Some ineffectual attempts have been made to shield the sliding surfaces, but usually they are left fully exposed and always unsatisfactory. This can be wholly avoided by the plan shown in Figs. 4 and 5, which not only locates the fitted surfaces away from the chance of catching chips and dirt, but by extending the slides up above the top of knee, the strain is better resisted, and the slide and guide can be of equal length. All dirt and chips that can get in between post and knee can pass down freely through the space between the two. When the time comes, and these vertical slides become slides in fact and not simply places for adjustment, with the sliding surfaces so proportioned as to remain true, annual refitting can be dispensed with, and the workmen that operate the machines may enjoy a little satisfaction.

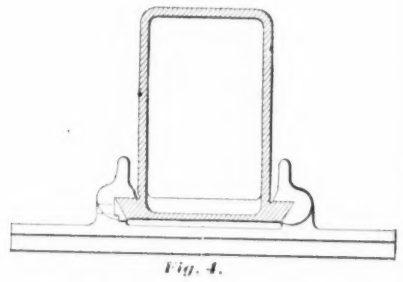


Fig. 4.

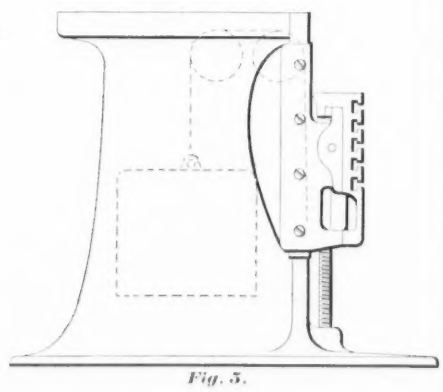


Fig. 5.

In changing from machines of the planing machine sort to ones using rotary cutters, something besides simply putting the spindle in place of the tool is necessary. In a planing machine or shaper the cross-slide seldom moves under strain, and has but little movement at the most, while with the rotary spindle the slide is half the time moving while the tool is at work, and the strain being excessive, unless special provision is made for length and breadth of surface, the machines will need much too frequent refitting.

The real merit in these machines lays in the speed, accuracy and finish given to the work turned out, and unless the surfaces are true the loss may overbalance the gain, and it is in these machines particularly, where the designers are not compelled to follow precedents, that they can put in study to advantage.

Designing New Machinery.

By HENRY B. MORRIS.

III.

When you have carefully studied out the general plan of the new machine which you propose to build, and are ready, or think you are, to begin operations, your first care must be to make thorough and complete drawings, both general and detail. Many well-meaning men regard this as quite unnecessary. They think that as the machine is largely experimental, and only one is to be built at first, the cheapest and crudest sketches and diagrams will do. But they won't. If the machine is expected to work when it is done, the drawings should be as good in all respects as for a standard article of which you build fifty at a time. And because the machine is novel, all the more reason exists for fully illustrating in detail its peculiar parts.

When your general drawings are made, before you go any farther, look the whole thing over with the object of simplifying it, throwing out superfluous parts, and improving those that remain. I have seen very few cases where the draftsman was not fully rewarded by discoveries in this line for the time so spent.

In designing your machine, trust nothing to luck. Let every part be the result of calculation, study and a good reason. If the thing is at all intricate, or is intended to operate upon some troublesome material, you will study it, I'll warrant, before you are through. And you will be certain to find that the machine, in its faulty performance, will take merciless revenge for any neglect or over-sanguine presumption of yours. The first part of the construction process is always easy enough—planing up a bed-plate, for instance, and the standards, and mounting the main pieces. It is at the last, when the machine is asked to do its expected duty, that your real troubles begin; you will, therefore, do well to anticipate and provide for them, at the earliest possible stage of the performance.

No matter how anxious you, or others, are for the completion of the new apparatus, don't begin building it until your drawings are done, and you are satisfied with them. Don't undertake to make a pattern, or a forging; as a rule, nothing is gained by such haste, even when the work is not rendered useless by subsequent changes in the drawings. And if you are obliged to superintend such work, it will probably distract your mind from the real business of the hour.

If you are a young man, and this is your first operation of this nature, don't try to be ingenious, and to do startling things in the way of design. You are likely to have startling experiences enough to fully satisfy you before you are through. Remember that originality is not demanded of a machine designer as it is of an author; therefore, plagiarism is no sin. And you cannot do better than to pursue the safe course of copying such devices as you can from machines already doing some analogous work. Let there be as few unknown and untried contrivances as possible in your machine. Every one of them, whatever else it may accomplish, certainly adds to your difficulties and to your chances of failure. A safe designer is more highly valued than an ingenious one.

Above all things, if you are doing this job for some one else, let him furnish the enthusiasm. Be very guarded in what you say, and always speak of a successful result as a thing more or less uncertain. For this is just what it is. Don't make rose-colored predictions as to what the new machine will do, for new machines have a most distressing way of dishonoring promises that are made for them. Don't be led into telling him even that you "hope" the thing will make sixty revolutions a minute, with a corresponding output of fish-hooks, or whatever they are, for it probably won't; at least, not the first one. If you keep your opinions largely to yourself, your success will be as fully appreciated when it comes, as if you had boasted of it all the way through.

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NEW YORK, MARCH 17, 1892

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Change of Location.

On May 1st, the AMERICAN MACHINIST offices will be moved about two blocks west from their present location to the new *Mail and Express* building, which fronts on Broadway, at No. 203, and on Fulton street, numbers 164–8. We shall then have increased room and every convenience and facility for carrying on our work.

Executive Ability Among Mechanics.

One of the strangest notions ever conceived, we think, is that which leads some men to declare that the best foremen and superintendents are those who have executive ability and nothing else to qualify them for their positions. We believe in executive ability, and that the possession of it is highly important to him who is to direct the energies of others; but is it not just possible that we hear a little too much about executive ability, and not enough about first-class mechanical ability?

This worship of "executive ability" seems to have grown in some quarters beyond reason, until men are heard to declare that so long as a man has that he is sure to be successful as foreman of a machine shop, for instance, no matter if he never worked a day as a machinist; and some even go further than this, and declare that the man who is really a fine workman must necessarily possess such a mental constitution as to unfit him for a foremanship or superintendency, and that good mechanics seldom possess "executive ability." There never was a greater fallacy. A really good mechanic knows not only how to file straight, but how to plan and manage his work to make it efficient, and to avoid the useless expenditure of time and energy. To say that the possession of those qualities of mind which enable him to do this, constitute prima facie evidence that he is incapable of directing the work of others, is little short of silly.

It is very true that many good mechanics have not the necessary qualifications for good foremen, but the same is true of any other class of men which might be selected, and we emphatically deny that, proportionately, fewer mechanics possess executive ability than is the case with other men—time keepers, book-keepers, laborers or draftsmen, for instance.

Many good machinists have, on trial, proven themselves to be unfitted for foremanships, but this no more proves that good machinists are necessarily unfitted for foremen than the occasional success of a time-keeper as foreman of a machine shop proves that all time-keepers necessarily make good machine-shop foremen.

There are occasional instances where men who were not machinists have made fairly good foremen of machine shops, but for every such case there are a hundred in which good machinists have made good foremen of machine shops, for it must certainly be agreed to that, other things being equal, the man who has the best knowledge of the work being done, is best able to direct the doing of it. To affirm the contrary is equivalent to saying that the best general is one who has "executive ability," and knows nothing of military matters, nor of war.

To place over a lot of mechanics, to direct their work, a man as foreman, who is himself not a mechanic, on the plea that no mechanic is fit to direct the work of other mechanics, or that "mechanics never have executive ability," is not only a mistake, but is an injustice if not an insult, which the men are justified in resenting.

Ambitious men work for something more than daily wages, and to tell them that if they succeed in becoming good mechanics, that will be proof that they are unfitted for the higher positions, is to tell them something which it is to be hoped not one of them will believe, as, happily, very few of them do.

It may, and occasionally does happen, that some man, not a mechanic, who has been long connected with a certain shop, in such a way as to become familiar with the work carried on in it, becomes a good foreman of that shop, and a foreman whom the men can work for in comfort, and without sacrifice of self-respect, but such cases are exceptional, and our advice is, to any one who is in need of a foreman for a machine shop or for a foundry, to look among machinists or foundrymen for the man, and if the first machinist or molder tried does not succeed, then to try another and another until one is found that does succeed, resting assured that as great a proportion of such men will be found to possess "executive ability" as in any other class of men whatever, and when a mechanic is found who possesses this, he will be a foreman whom no man not a mechanic can approach in value. And the same can be said for foreman of the pattern shop, blacksmith shop, or any other shop in which mechanics are employed "Executive ability" has been exalted unduly, and we constantly see it alluded as "that rare quality," as though it were possessed by but very few. Experience is daily showing that it is more common than its worshipers believe it to be, and that many men who have previously given no evidence of its possession do give abundance of evidence of it when placed in a position demanding it.

A few years since some learned men predicted an impending failure of the coal supply, owing to the immense quantity being mined for manufacturing and other purposes. They showed by the proverbial truthfulness of figures that the supply was limited, and that mankind at the then present rate of consumption would soon be without fuel, at least without fuel in the form of coal. No doubt these men would have been much relieved could they have foreseen the improvements that came later on in the steam engine, in furnaces, in stoves, in fact, in pretty much everything in and about which coal was used for producing heat; improvements by which a much greater percentage of the heat of combustion is utilized than formerly. But there would have been little cause for felicitation in this respect, could it have been seen at the same time that more coal per individual would be burned today than ever before, which we believe to be true. People warm their houses better, and the cheaper prices of manufactured articles and goods, due to the wonderful improvement in manufacture and to the more economical use of fuel, have placed such things at the disposal of the many instead of the few. We do not, however, believe that there is imminent danger of exhausting the supply of coal. There was perhaps some mistake in handling the figures. So long as men get plenty of work at good wages or opportunities to work for themselves, enabling them to try to supply their needs and tastes, coal will be mined in an increasing ratio, and if it does become exhausted other sources of heat will probably be found.

Literary Notes.

MANUAL FOR BUILDING AND LOAN ASSOCIATIONS Embracing the Origin and History of Co-operative Societies; Objects and Benefits of Building Associations; Plans and Methods of Organizing and Conducting them; Leagues; Legislation; Constitution and By-laws; Forms and Description of Books, Blanks and Papers; Interest and Dividend Tables; Auditing and Supervision; The "National" Associations and a Comprehensive Variety of Practical and Useful Information and Suggestions By Henry S. Rosenthal. Second Edition, Revised and Enlarged.

Persons who wish to become members of a co-operative society, and even members of such, cannot do better than procure a copy of this manual. It gives specific information in reference to proper method for organizing and conducting building and loan associations, and many valuable hints that every one interested in these institutions should know. It is well written, all the subjects are treated in a popular manner, and will interest the reader from the first to the last of its 310 pages, not including the index, which last makes the book a convenient one for reference. The subjects treated in the different chapters relate to early history, objects and characteristics, advantages of membership in building and loan associations; forms of associations; building association leagues; legislation; how to organize; stock and stockholders; duties and rights of members; loans and securities; corporate government, elections and duties of officers; powers and liabilities; auditing, its purpose and methods; legal forms for associations and reports. The book gives ample evidence of the author's personal experience, observation and knowledge of the theoretical and practical workings of building and loan associations, and enabled him to bring out a book which is a valuable addition to this class of literature, and throws much light on the character of these associations, with which the initiated and uninitiated should be familiar. The book is published by S. Rosenthal & Company, Cincinnati, Ohio. Price, $1.50.

SCREW THREADS. By Paul N. Hasluck.

This is the third revised and enlarged edition of a book which has met with much favor among mechanics, being small enough for the vest-pocket and yet containing much information of a practical nature concerning screw threads and the cutting of them. Though it is an English book, it will be found to do full justice to the American system of screw threads, and many American tools for cutting and gauging threads are illustrated. So far as the principles of screw cutting are concerned they are the same the world over, of course, and therefore American mechanics who wish to have at hand rules for cutting threads on the lathe will find useful ones in this book, and tables as well, giving dimensions of Whitworth's, Holtzapffel's, Swiss Small Screw, French Standard and Sellers' or U. S. Standard threads. It is published by Crosby, Lockwood & Son, London, and the D. Van Nostrand Co., this city, price 60 cents.

TIN AND TIN-PLATE. THEIR HISTORY, PRODUCTION AND STATISTICS.

This is a supplement to the *American Manufacturer*, written by Mr. Jos. D. Weeks, and relates entirely to the history, production and manufacture of tin and tin-plate. It contains much information on this subject and is liberally illustrated. Its price is 50 cents, and it may be obtained by addressing the above at Pittsburgh, Pa.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(95) C. C., Attleboro, Mass, writes: Please inform me through your question and answer columns whether there is an English translation of "Der Constructeur," by F. Reaulaux? *A.*—We do not know of any other but that which ran through *Mechanics*, published at 430 Walnut street, Philadelphia.

(96) F. W. T., St. Johnsbury, Vt., writes: Please let me know through your columns of the best modern work on nickel plating, together with the price and address of the publishers. *A.*—"Watt's Electro Deposition" is said to be a very good work; it can be had of D. Van Nostrand Company, 23 Murray and 27 Warren streets, New York. Price, $3.50.

(97) W. A. V., —— writes: Please let me know through your columns where I can obtain a good book on designing steam pumps. Also one for designing shaft governors for automatic cut-off engines. Please state the price of the books *A.*—Practical hand-book on pump construction by P. R. Bjoerling, published by E. & F. N. Spon, 12 Cortlandt street, New York, we believe to be a good one. Price, $1.50. We do not know of any book that treats on shaft governors.

(98) H. D. T., Rochester, N. Y., asks: What will be the absolute steam pressure per square inch in a 2x2½ inch cylinder? *A.*—The absolute pressure of steam is its pressure reckoned from vacuum; it is the pressure as shown by an ordinary steam gauge, plus the pressure of the atmosphere;

the latter is usually reckoned at 14.7 pounds per square inch, hence to compute the absolute pressure in your cylinder, add 14.7 pounds to pressure indicated by the steam gauge.

(99) F. S., Kansas City, Kan., writes: Please inform me through your columns of a good work on locomotive valve motion, also the publisher's name. *A.*—Practical Application of the Slide Valve and Link Motion, by W. S. Auchincloss, C. E., published by D. Van Nostrand Company, 23 Murray and 27 Warren streets, New York, is considered a standard work. You will also find the subject thoroughly discussed in the articles on Modern Locomotive Construction, recently completed in our columns.

(100) J. C., Philadelphia, Pa., writes: Kindly compute the horse-power from the inclosed card. I am studying indicator practice by F. F. Hemenway, and I would like to see if I understand it correctly. I make the horse-power 252. Cylinder is 24⅝ inches diameter; stroke, 36 inches; 84 revolutions per minute; spring, 40. *A.*—We find the mean effective pressure to be 35 pounds per square inch of piston, from which we get 254 horse-power, fraction neglected. You undoubtedly understand the book as far as you have studied it.

(101) J. H. P., Baltimore, Md., writes: Please inform me what kind of varnish I can use on mechanical drawings; the same must be white, transparent, dry quickly and hard, and have a glaze. I have tried, but cannot find anything to answer the purpose. There is a varnish used in locomotive shops, but it seems to be kept there. *A.*—The varnish used in many locomotive and other shops is simply white shellac dissolved in alcohol. It requires a little experience to mix these to the proper consistency, but this you will soon acquire.

(102) J. H. S., Detroit, Mich., writes: Please inform me through your paper the best way to find the horse-power of a steam engine. *A.*—See answer to Question 55 in our issue of February 11, current volume. 2. What is the best kind of a lathe tool for turning paper? *A.*—We have had no experience in this line of work. It seems to us that a few experiments will indicate the best kind of tool to adopt, but perhaps some of our readers who have had experience in turning paper will enlighten us.

(103) A. F., Bridgeport, Conn., writes: Being a little in doubt as to the power of two engines, I refer to you the following: We wish to make a change and replace in our boat a 12x12 simple condensing engine cutting off at 6 inches, by a fore and aft compound engine; high-pressure cylinder, 9 inches diameter; low-pressure cylinder, 18 inches diameter; both 9 inches stroke, and cutting off at the same point. Steam pressure in both engines is 100 pounds, and in both cases the ordinary slide valve is used. *A.*—From the meager data given we should estimate these engines to be equal in horse-power.

(104) G. S. G., Westminster, Mass., writes: Kindly give me through your columns directions for making a reliable cement for leather belts. *A.*—Take equal parts of common glue and isinglass, put them in a glue-pot with just enough water to cover them. Let them soak eight or ten hours, then apply heat till the mixture begins to boil. Add tannin till the mixture presents a ropy appearance. 2. What is the mixture of lead, sulphur, etc., that will swell in cooling? It is to be used for fastening bolts in steam-engine foundations. *A.*—Lead, 9; antimony, 2; bismuth, 1.

(105) H. C. W., Huntingdon, Pa., writes: I would like to study mechanical drawing, and want to follow such a course of study and practice as will enable me to do locomotive work. I would like you to advise me what works to take up, and also what or how many instruments will be necessary. *A.*—We believe that you cannot do better than to follow the instructions given in articles on Practical Drawing, recently completed in our columns. In these you will find illustrations and descriptions of instruments required. If in connection with this, you study the articles treating on Modern Locomotive Construction, which have also appeared in our columns, you will obtain the desired practice.

(106) F. R. B., Owosso, Mich., writes: We have a system of heating, but it does not work well. Pipes are overhead at a height of 3 feet above the water level in the boiler. The drip-pipe for returning the drip to the boiler enters at about 6 inches from the bottom of the boiler, and is provided with a check valve; but the drip will not enter the boiler. All pipes are 1 inch in diameter. Please state the difficulty. *A.*—Your data is not complete enough for an opinion. But it is evident that there is not a head sufficient to overcome the friction in the pipes and the pressure in the boiler. The friction may be excessive on account of having too many bends or elbows in the pipes, and a return pipe too small in diameter.

(107) J. M. H., Montclair, N. J., writes: I wish to procure a book or sheet, containing conventional sectional signs for draftsmen I do not mean the ordinary typographical signs; what I wish to ascertain is the method of correctly representing different materials, such as wood, stone, natural rock, steel, iron, etc., in section. A friend has told me that these were published some time ago in your paper. *A.*—See our issue of April 9, 1887. Although the system given in this issue is a good one, it must be understood that draftsmen have not agreed on a standard; many have a system of their own. The consequence is that, no matter how correctly the sectioning may be done, confusion will ensue, unless you write plainly on the drawing what kind of material each section represents.

(108) D. R., Pueblo, Col., writes: I wish to convey water from a ditch through a pipe 260 feet long, with a fall of 24 feet. I would like to know what is the smallest size of pipe that I can use and have a supply of three gallons per minute. *A.*—We should not use a pipe less than ¼ inch inside diameter. This will give you a greater supply than you require, provided the pipe is smooth and without elbows or bends. 2. Please give me a rule for calculating the flow of water through a pipe of given length and fall. *A.*—The flow will depend on the diameter of the pipe, if this is known, and the length and head are given, then find the velocity of flow, and multiply the velocity by the area of the pipe as explained in our answer to Question 21 in our issue of January 14, current volume.

(109) A. W., Milwaukee, Wis., writes: Kindly inform me as to what is generally used for packing for cylinder heads and valve stems in gas engine? *A.*—That depends on the design of engine; in some constructions no packing will be required; in others, the packing is similar to, and varies in kind as much as that used in ordinary steam engines. 2. I want to make a governor for a gas engine; the bore of cylinder is 5 inches; number of revolutions 200 per minute; work of governor is very light; can you give me some data as a guide? Is there any book published treating on the construction of gas engines? If so, please give me the name. *A.*—"The Gas Engine," by Dugald Clerk, published by John Wiley & Sons, 53 East Tenth street, New York. This book also treats on the type of governors used on gas engines, and may furnish you the data you seek.

(110) H. W. J., New Britain, Conn., writes: Please answer the following through your columns: We have in our shop a boiler 15 feet long, 5 feet diameter, with 66 three-inch tubes. The boiler is rated at 78 horse power. Is that not too high? Please inform me how to compute the heating surface of a boiler. Is the water or fire surface of the shell used? In a recent answer you stated that 15 square feet was allowed for one horse-power. How many horse power would this boiler have at that rate? And how many square feet of heating surface should it have at that rating for 70 horse-power? *A.*—In computing the heating surface of a boiler all the surfaces of the shell and tubes which transmit heat to the water are considered as heating surface. Thus we shall assume that two thirds of the shell is heating surface. The circumference of 5 feet is 1.57 feet; two-thirds of this is $\frac{15.7 \times 2}{3} = 10.36$ feet; multiplying this by the length of the boiler we have $10.36 \times 15 = 155.4$ square feet of heating surface in the shell; to this we should add the heating surface of the heads, which is found by subtracting from those portions of the heads which transmit heat to the water, the surface cut out for the tubes; say that this amounts to 20 square feet. The circumference of one tube is .785 foot, multiplying this by the length we have $.785 \times 15 = 11.775$ square feet of heating surface in one tube, and in 66 tubes we have $11.775 \times 66 = 777.15$ square feet. Now the total heating surface will be $155.4 + 20 + 777.15 = 952.55$ square feet. Allowing 15 square feet per horse-power we have $\frac{952.55}{15} = 63.5$ horse-power. At this rate $70 \times 15 = 1{,}050$ square feet will be required for a 70 horse-power boiler. It should be remembered that the term horse-power is a very vague term. Much depends on the kind of engine to which steam is supplied; in some cases it may appear that the boiler furnishes steam for a greater horse-power, and consequently would be rated higher, and in other cases it appears to furnish steam for a smaller horse-power, and would be rated much lower. If a boiler is tested and a statement of its horse-power desired, without regard to whether it is to supply its steam to drive an engine or other purposes, then it is agreed among the majority of experts of the United States to consider 30 pounds of water per hour evaporated, at 70 pounds pressure, from 100 degrees as a horse-power, or 34½ pounds of water per hour evaporated, from and at 212 degrees.

(111) J. H. M., Lancaster, Pa., writes: I have set a boiler for heating purposes. Its shell is 4 feet 9½ inches high, diameter 37 inches, center flue or magazine 19 inches diameter. The boiler has forty two 2-inch flues leading the gases upwards; and thirty-three 2 inch flues leading the gases downward; the latter flues form the extreme outside circular row. The fire-box is 22 inches high, 27 inches diameter. The boiler consumes about 3,600 pounds of coal per month. I have a 2½ inch pipe with a T reduced to 2 inches for feed mains piped to about 450 feet of radiating surface, which gives very indifferent results. The smoke pipe is 12 inches in diameter, and connected to a 12x12 inch flue. Could I gain anything by removing the magazine and covering the top opening with a close fitting lid, so as to stop the heat from leaving the fire-box by the central flue, and compel the gases to escape through the flues? It appears to me that the boiler is fully large for this radiating surface, which we propose to increase to about double or nearly so. At present it makes steam very slowly with too great a coal consumption. The fire is kept in good condition with a water line of 40 inches from bottom of boiler shell. I want to get out this boiler all that is in it, but I must confess that it appears to be a failure so far. The building is well piped. Could you not suggest some remedy, or give some reason of its failure? *A.*—It is difficult to locate the trouble without making an examination of the whole arrangement. The change you propose to make in the boiler will not be an improvement, and will not give any better results; in fact, your sketch indicates a good boiler, and we do not see where you can improve it. Our opinion is that the indifferent results of which you complain are due to badly constructed radiators, or faulty arrangement; and the slow steaming of the boiler is due to an insufficient draught, which may be caused by a faulty construction of chimney, or the arrangement of flues leading into it. Then again the building may be much exposed, and have many windows, which if taken into consideration may give a better appearance to the results.

(112) C. H. G., East Boston, Mass., writes: I am about to build a small boat engine 3½x5½ inches; steam supply pipe, 1 inch; exhaust pipe, 1¼ inch; travel of valve, 1⅝; exhaust port, ¾ inch wide; bridges, ¼ inch wide; steam pressure, 150 pounds. What I should like to know is the length and width of the steam ports, outside and inside lap. If you should state $\frac{5}{16}$ inch lap, I suppose you mean the amount of overlap when the valve stands in a central position. I do not understand these terms as engineers do, and I wish you would put them in plain language. *A.*—Assume the valve to be placed in its central position, then the distance which either edge of the valve overlaps the outside edges of the steam port is called outside lap, steam lap, or simply lap of the valve; the distance by which the valve extends beyond the exhaust edge, or the inner edge of the steam port, is called the inside lap or exhaust lap. Valves are sometimes so made that the steam is admitted by the inside and exhausted by the outside edges. Hence the term inside and outside lap are somewhat ambiguous. The terms steam lap and exhaust lap avoid this ambiguity and are to be preferred. The exhaust lap is always much smaller than the steam lap. It is frequently absent, and frequently the exhaust edge of the valve does not reach the exhaust edge of the port. In that case the amount that the valve lacks in covering the steam port is called inside clearance, and sometimes it is called negative inside or exhaust lap. The measurement for both steam and exhaust lap is made for one end of the valve only. If a valve is said to have ⅛ inch lap, the meaning is that it has that much at each end. It seems to us that a study of the book treating on slide valve gears, by F. A. Halsey, and published by D. Van Nostrand Company, New York, will be of great aid to you; it is plainly written and you will have no difficulty in understanding it. We should make the steam ports, in the engine to which you refer, two inches long and ⅝ inch wide, and give the valve ⅝ inch outside lap, and only sufficient inside or exhaust lap to make sure that steam ports are covered when the valve is in its central position. 2. In looking over some back numbers for information I find in your issue of January 1, 1891, Question 11, a compound engine with high-pressure cylinder 2⅝ inches diameter; low-pressure cylinder, 5½ inches diameter; stroke of both cylinders, 4 inches. Why is the stroke made so short? *A.*—This stroke is not any shorter than is usually adopted for marine engines of this size. It is of importance to keep the center of gravity of a marine engine as low as possible, and therefore the stroke is frequently less as would be adopted for other classes of engines. 3. In your issue of October 29, 1891, Question 474, you describe a yacht engine with cylinder 3x5½, running at the rate of 340 turns per minute; boiler pressure, 150 pounds. How many horse-power will she develop? *A.*—We should estimate it to be seven horse power.

BUSINESS SPECIALS

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Note the cat on page 20.

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"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Some Peculiar Indicator Diagrams.

BY PROF. DEVOLSON WOOD.

In my lectures upon the indicator at the institute, I give certain modifications of the diagram which do not ordinarily occur in practice, although all may be produced by the actual engine. The working out and interpreting of these diagrams may be considered a kind of test of the knowledge of the student, and of his appreciation of the facts actually occurring in regard to the distribution of steam. I will here give a few of these exercises:

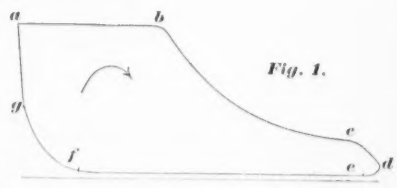

Fig. 1.

Let Fig. 1 be a typical diagram under normal conditions. Some of these lines depend, for their form, upon the speed of the engine.

Let the engine move *very* slow, then will the steam line *a b* and expansion line *b c* be the same as in Fig. 1. At *c*, Fig. 2, the release takes place, and as the steam escapes before the piston advances, the exhaust line *c d* of Fig. 1 becomes vertical in Fig. 2, falling to the back pressure line at *e*. The piston then moves on to *d*, the exhaust being open; thence back to *f*, when it closes, after which the compression *f g* will be the same as before. But when the feed opens at *g*

the admission line becomes vertical, rising to *h*, instead of being inclined as *g a* in Fig. 1.

Let the same engine now be forced to run backward. The curve may be constructed from Fig. 2 by passing around left-handed. In the same end of the cylinder steam will

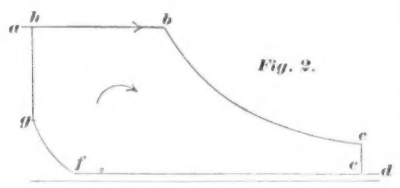

Fig. 2.

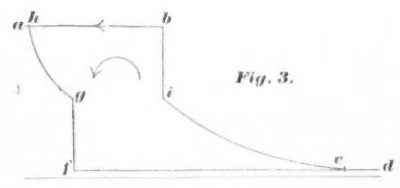

Fig. 3.

be admitted at *b*, Fig. 3, the valve opening more and more, and then beginning to close, but when the piston has reached the end of the stroke at *a* the valve will not have entirely closed, but it will close at *h* on the return stroke, and the steam in that end of

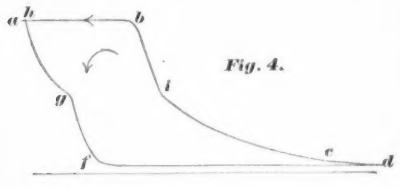

Fig. 4.

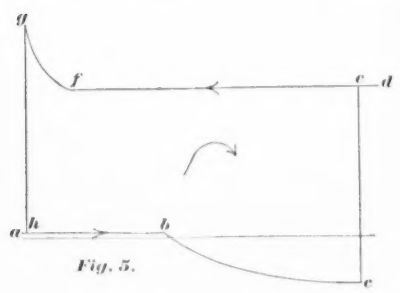

Fig. 5.

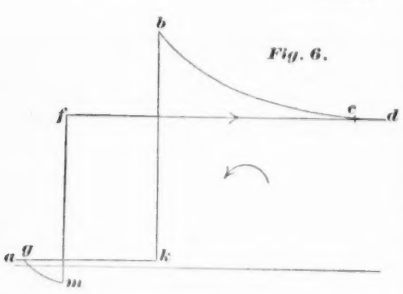

Fig. 6.

the cylinder will expand to *g*. If the clearance line be located the conventional expansion curve may be constructed. At *g* the release opens, and the release line *g f* falls vertically if the engine barely "creeps." The exhaust remains open until the piston has

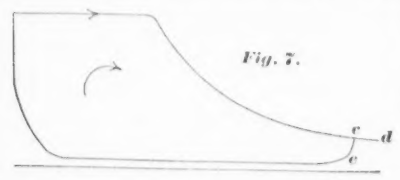

Fig. 7.

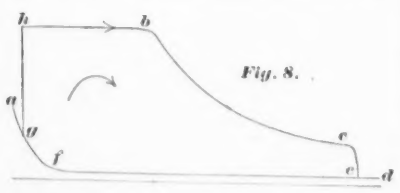

Fig. 8.

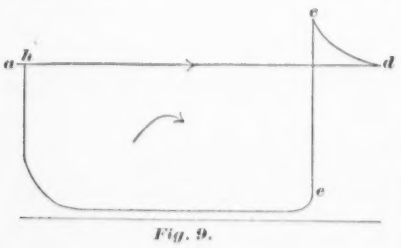

Fig. 9.

reached the end of the stroke *d*, and returned to *c*, where it closes; and the little steam remaining in the cylinder is compressed to *i*. In Fig. 2 steam was cut off at *b*, but now the valve begins to open and the steam line *i b* rises vertically.

Fig. 4 represents the same engine running with some speed.

Next let the feed-pipe be attached to the exhaust nozzle, and the exhaust be at the feed-pipe.

The valve for this case must be a piston, or by some means be held on the seat, as the action of the steam would tend to lift it from the seat.

Fig. 5 is the diagram if the engine run right-handed, the engine running *very* slow; the feed in Fig. 5 will correspond to the exhaust in Fig. 2, and the converse. The steam line *a b*, Fig. 2, will be a back-pressure line *a b*, Fig. 5. At *b* the exhaust will be closed, and the steam in that end of the cylinder will be expanded as represented by *b c* in both Figs. 1 and 5. At *c*, before the end of the stroke, the exhaust in Fig. 1 opens and becomes the feed in Fig. 5, and the line *c e* rises vertically—or very nearly so—if the engine runs sufficiently slow. The full pressure of steam is realized from *e* to *d*, Fig. 5, and from *a* to *f*, corresponding to the same letters in Fig. 1. At *f*, Fig. 1, exhaust closes, so that in Fig. 5 feed closes and compression takes place from *f* to *g*, where feed port in Fig. 1 opens, and in Fig. 5 exhaust opens and the pressure drops from *g* to *h*, and the piston goes to *a* with exhaust open. In this case the engine is *forced* to turn backwards.

Next let the feed be at the exhaust, and exhaust at the feed as above, and the engine turn left-handed.

In Fig. 2 the exhaust is closed at *f*, and for the reverse motion will just be open as in Fig. 6 and remain open to *d* and back to *c*, where it will close and compression take place from *c* to *b*, where cut-off takes place in Fig. 2 and release in Fig. 6, the pressure falling from *b* to *k*; thence to *a*, back to *g*; thence expansion to *m*, from which the pressure rises to the initial at *f*. This case has actually taken place.

All the above examples are for a certain setting of the valve.

Next, suppose that the valve is so made and set that the release is negative, that is, does not open until after the beginning of the return stroke. If there be no leakage or other cause for loss of pressure, the compression line *d c*, Fig. 7, will follow back on the expansion line until the release takes place, as at *c*, when the pressure will fall. A case of this kind was brought to me recently by one of our graduates to be interpreted, as he thought the engine did not run properly. In his case, however, for a certain cut-off the release did not take place until the piston had traveled back about half the expansion line, and the pressure remained nearly constant from that point to near the end of the stroke.

Next, if the lead be negative and the engine runs *very* slow, the card will be as shown in Fig. 8.

Another novel case would be that in which steam follows the piston at full pressure, and release not take place until some point in the back stroke. This is shown in Fig. 9. The full pressure is along the line *a d*, and on the return stroke compression takes place along the line *d c*, and if release takes place at *c* the pressure falls to *e*.

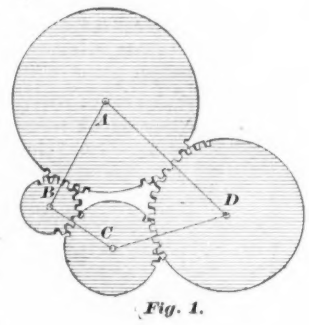

Fig. 1.

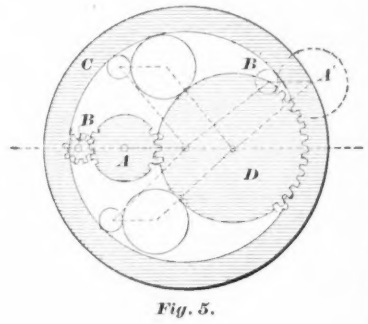

Fig. 5.

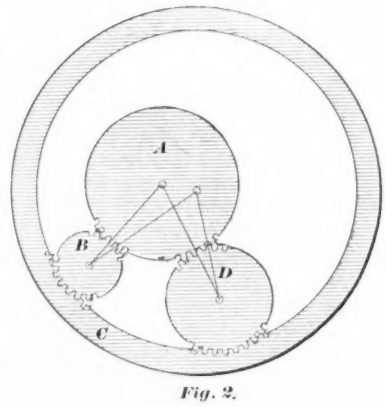

Fig. 2.

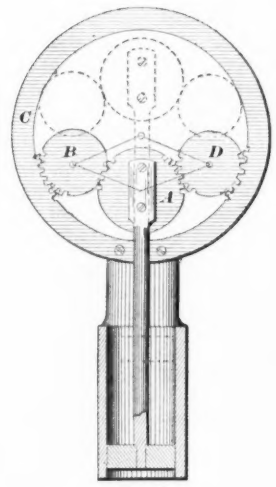

Fig. 6.

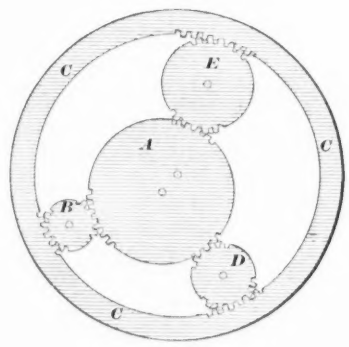

Fig. 3.

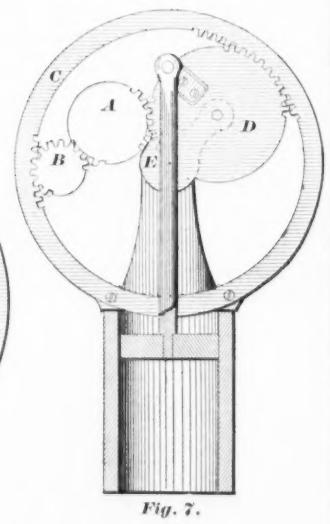

Fig. 7.

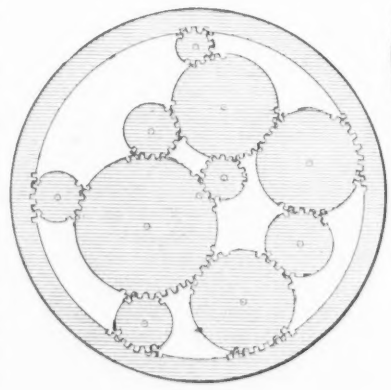
Fig. 4.

The Free Internal Train.

By George B. Grant.

There is a combination of gearing that possesses an interesting property that I believe has not been published, and which may have practical value as well as theoretical interest. I will call it a "free internal train."

Any four gears, Fig. 1, when so arranged that the opposite gears do not engage, will form a complete but loose train, rolling together perfectly if their centers are kept from separating. It is called a quadrilateral train, from the figure formed by the four lines of centers. This being true of any four gears is true when one of them is a rack, or an internal gear, as in Fig. 2.

If now we fit a fourth gear *E*, Fig. 3, to the loose train *A B C D*, we get a fixed train that is in reality a combination of three loose trains. All four gears will revolve freely within the internal gear, maintaining their original relative positions without the agency of shafts or links. We can combine several trains in one, as in Fig. 4.

For that particular case of the loose internal train of Fig. 2, when the quadrilateral becomes a parallelogram, we have the singular train of Fig. 5—the "free internal train." The sum of the diameters of the three pinions is equal to the diameter of the internal gear. The three pinions can be rolled about within the internal gear, but cannot be separated, being both fixed and loose. The motion is practically limited to the contact of *A* with *C*, but theoretically will make a complete revolution, as indicated by the dotted pitch lines *A'* and *B'*.

This train will form a new "parallel motion," or mechanical element, by which a straight line is produced without resort to a previously formed straight guide, for if, as in Fig. 6, the gears *B* and *D* are equal, the parallelogram becomes equilateral, and the intermediate gear *A* will move bodily in a straight line.

White's parallel motion, Fig. 7, is the only other one known to me by which a straight line is produced directly by the movement of gears, and that has the defect that it is loose and requires a link *E* to keep the gear in its place. If the gears *A* and *B* should be added, a free internal train would be formed, and another true parallel motion would be derived from gears alone.

The Free Internal Train.

School of Marine Engineering.

There has been established at Cornell University a school of Marine Engineering and Naval Architecture, the first school of its kind in this country. Professor Thurston, as director of Sibley College, will be at the head of this department; those immediately in charge being: Mr. William F. Durand, Ph.D., principal of the school and Associate Professor of Marine Engineering, and George Robert McDermott, Assistant Professor of Naval Architecture. Both these gentlemen have, we understand, not only been educated in the line of their proposed work, but have been engaged in the actual work at shipyards, where they have gained the practical experience, without which, of course, no one can class himself as a marine engineer. The growth of shipbuilding in this country has made it difficult for shipbuilders to obtain men acquainted with the work or sufficiently acquainted with the principles involved in it to enable them readily to take hold of it, and it is the demand for such men that this school is designed to supply. It is not claimed that everything pertaining to the art of shipbuilding can be learned in any school, or that considerable experience will not be required after graduation to perfect graduates as engineers, but it is designed to do all for students that can be done short of practical experience—to give them a thorough acquaintance with the underlying principles of the subject, and to help to acquire with the least possible waste of time and effort that which could otherwise be learned only at a disadvantage. Full particulars regarding this can be had by applying to Professor R. H. Thurston, Ithaca, N. Y.

MANUFACTURES.

A plant for electric lighting is to be established at Ukiah, Cal.

The Penn Hardware Co., of Reading, Pa., have just erected a new brass foundry, 40x120 feet.

The Titusville (Fla.) Electric Light Company is reported as erecting a new electric light plant.

The El Paso (Texas) Water Co. is reported as to erect a new pumping station at its water-works.

New machinery will be placed in the Sanford (Fla.) Ice and Cold Storage Company's plant.

Whittemore & Maxon's new machine shop at Bay City, Mich., is nearly ready for occupancy.

The organization of a $25,000 stock company, to establish a stove foundry, is projected at Ashland, Ky.

The new furnace of the North Carolina Steel and Iron Co., at Greensboro, N. C., is nearing completion.

Mr. Albert J. Kelting has opened a general jobbing machine shop at No. 459 Carroll street, Brooklyn, N. Y.

According to report the sum of $3,000 has been voted for the purchase of a fire protection for Carberry, Mass.

It is reported that a contract has been signed for the erection of a wire-mill at the copper mines in Henrietta, Tex.

J. H. McDougal, of Carberry, Manitoba, is getting ready to build a planing-mill, and equip it with the latest machinery.

G. W. Prentiss & Co., of Holyoke, Mass., have just added a department for the manufacture of high-grade cast-steel wire.

It is reported that the municipality of North Cypress are agitating the establishment of an oatmeal mill in Carberry, Manitoba.

It is stated that a three-story cotton-mill, 150x80, will be built at Jewett City, Conn. It is to have 500 looms and 800 operatives.

It is said that Pennsylvania and Toledo capitalists will establish works at Toledo, O., for the manufacture of railroad supplies.

J. H. Cole, of Parkersburg, W. Va., is talking of removing his iron foundry, machine shop and boiler works to Bridgeport, Ala.

George A. Reed, of North Andover, is to establish a brass foundry at Gloucester, Mass., and will erect a building 36x36 feet at once.

The Adams Hardware Company, capital, $50,000, has been incorporated, at Jacksonville, Fla., by M. R. Bacon, T. J. Adams and others.

The plant of the Somersworth Machine Co., of Dover, Mass., has been enlarged and improved, and 250 men will soon be employed.

The Citizens' Electric Light & Power Co., Baton Rouge, La., will improve, it is said, and put new machinery in its electric light plant.

Work will soon commence on the erection of a new foundry, 100x380 feet, for the Schenectady Locomotive Works, of Schenectady, N. Y.

The Richmond & Manchester Street Railway Co., Manchester, Va., will add three 150 horse power engines and dynamos each to its electric-power plant.

The commissioners of Colorado County, Texas, have in view the building of a $25,000 bridge over the Colorado River between Eagle Lake and Vox Populi.

The Hoppes Mfg. Co., of Springfield, O., makers of the "Hoppes" Live Steam Feed-water Purifiers, have commenced the erection of new shops in Springfield.

The Great Northern will build car and machine shops at Spokane, Washington, and it is stated that the Northern Pacific has also decided to build repair shops at that point.

H. S. Pattison, S. C. Reiley and J. S. Ducker have incorporated at Newport, Ky., the Pierce Manufacturing Co., to manufacture patent labor-saving devices; capital stock, $100,000.

The Manufacturing Construction Co., at Knoxville, Tenn., has applied for incorporation, with a capital stock of $250,000, for the construction of bridges and structural work of all kinds.

The Poland Paper Co., of Mechanic Falls, Me., has an architect at work on the plans of its new paper-mills. The new mill will add seven tons per day to the productive capacity of its plant.

The Philadelphia Engineering Works, manufacturers of Corliss steam engines at Philadelphia, have opened a branch office in the Phœnix Building, Chicago. It is in charge of Mr. Lindsay, one of the firm.

The Fitchburg (Mass.) Steam Engine Company expects to occupy its new shop, March 1. The boilers are set, the engine is ready to put in operation, and the shafting, belts and pulleys are in position.

The O'Neil Crossing Alarm Co., of Chicago, has been incorporated for the manufacture of railway crossing alarms; capital stock, $500,000; incorporators, W. D. Drake, J. C. O'Neil, J. Carroll, and W. P. Johnson.

Arthur Stern and others, of Cincinnati, O., are investigating with a view of purchasing the Walton Architectural Iron Works property at Covington, Ky., and equipping same for the manufacture of machine tools.

Owing to increase of business and consequent necessity for more room, Mr. Daniel Ashworth, Mechanical and Consulting Engineer, of Pittsburgh, Pa., has moved his offices to 108 Fourth avenue, that city.

The Pittsburgh Car Wheel Company, of Pittsburgh, has made application for a charter of incorporation. The incorporators are C. L. Magee, Jas. D. Callery, P. H. Griffin, Geo. L. McFarland and Robert J. Mercur.

The Maryland Steel Co., at Baltimore, Md., has decided to erect a large open-hearth furnace plant and plate and shape-mills, for turning out all varieties of material required for the construction of ships, bridges and buildings.

A bill has been introduced in and passed the legislature authorizing Warren County to borrow $12,000 for the construction of a bridge over one or each branch of the Shenandoah River at Riverton, Va. For particulars address County Clerk.

A new and very neat form of calendar is that just issued by the Morse Twist Drill and Machine Company, of New Bedford, Mass. It is in a frame of celluloid embellished with engravings of some of the leading tools made by them. The calendar is for 1892 and '93.

There is water-works agitation in Palestine, Tex.; Hubbard City, Tex; New Milford, Pa.; Bedford, Ind.; Silver Creek, N. Y.; Hattiesburg, Miss.; Rock Hill, S. C.; Portland, Oregon; Millheim, Pa.; Provincetown, Mass.; Ritzville, Wash.; Frostburg, Md.; Carthage, O.; Ilion, N. Y.

Thomas Carlin's Sons, Allegheny, Pa., send us their new and enlarged illustrated catalogue of contractors' tools and machinery brick plants, rolling-mill machinery, etc. The catalogue is a large one, and embraces a great variety of tools and machines, including steam engines and boilers.

The Concord Axle Company, Penacook (Concord), N. H., has issued a new and enlarged catalogue. The company makes axles for all kinds of wagons and carriages, also springs, tire benders and various other iron parts entering into their construction. The business was established in 1835.

Frasse & Co., 92 Park Row, New York, have issued catalogue "R" for 1892, which will be sent free on application. They are extensive dealers in fine tools and supplies, also foot-lathes, etc. The catalogue contains a large number of engravings of tools with their prices. It is a very convenient catalogue to have at hand.

The Shone Hydro-Pneumatic Sewage Co., of Chicago, have purchased half a block of ground on Forty-fifth street in that city, and are erecting an extensive machine shop for the manufacture of their ejectors and sewage appliances, which they have heretofore been importing from England. They are supplying the World's Fair among other large users.

The Whitney Safety Firearms Co., at Florence, Mass., is considering the moving of its works to Pennsylvania. The management has communicated with the McKeesport Board of Trade, and offers to locate in McKeesport if $150,000 worth of its stock is disposed of in that city and vicinity. The company manufactures hammerless rifles, shot-guns, etc., and employs about 200 men.

The Carlin Manufacturing Company, of Pittsburgh, has received the contract to furnish all of the iron work for the improvements on the shops of the Pittsburgh, Cincinnati, Chicago & St. Louis Railroad at Columbus, O. The improvements include additions to the paint shop, planing-mills and blacksmith shop. The total amount of money to be expended will be $50,000, largely of iron work.

Benjamin F. Kelley & Son, of 91 Liberty street New York, have published a pamphlet entitled, "Selecting an Engineer," in which an engineer applying for a position to take charge of a steam plant proves his competency to the satisfaction of the superintendent at least, by highly commending the Berryman feed water heater, for which Messrs. Kelley are the agents. It is a new idea in advertising.

The American Steel Railway Track Company has filed articles of incorporation in the Camden County (New Jersey) Clerk's office. The capital stock is $300,000. The incorporators are Charles E. Hellner, S. D. Nye and Reynold T. White, all of Boston, Mass.; Edward Dudley, of Camden, and Edward Greeley, of New York. The objects of the company are to manufacture or have manufactured and sell material for the construction of street railroads under letters patent.

Their experimental machinery for tinning the plates having been got into good running order, Norton Bros. have begun the erection at Maywood, Ill., of a building for use in the manufacture of tin plates. The storehouse and pickling department will occupy 85x85 feet, while the cleaning and tinning house will be 40x260 feet, affording, when fully equipped, an estimated capacity of 1,200 boxes of tin-plates in ten hours. It is hoped to have the new plant at work in about 90 days.

The Marion Steam Shovel Co., of Marion, O., is making extensive improvements to its plants, says the *Manufacturers' Record*. The building of additions was commenced in December last, and included a large and commodious office building, pattern shops, an addition to the machine shop, and an annex to the erecting department, of the dimensions 150x200, three stories in height. Some of these buildings are already under roof. All of the buildings are brick. When completed the entire works will cover 11½ acres, and will be one of the best arranged plants in the United States.

Machinists' Supplies and Iron.

NEW YORK, March 12, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $16.50 to $17.50; No. 2, $15.25 to $16.50; Grey Forge, $14 to $14.50. Southern brands of good quality are obtainable at $15.75 to $17 for No. 1 Foundry; $15 to $16 for No. 2; and $13.50 to $14 for Grey Forge.

Scotch Pig—Coltness is quoted at $21.50; and $20.25 for Eglington.

Antimony—Prices are steady, and the market is firmer.

We quote Hallett's, 10¾c.; Cookson's, 14½c. to 15c.; and L. X., 12c. to 12½c.

Copper—The market is unsettled. Lake copper is quoted at 10.60c. bid, and 10.75c. asked. Casting Copper is held at 10¼c.

Lead—There is an easier feeling at 4.15c. bid and 4.20c. asked.

Lard Oil—The market is firm at 56c. to 57c. for Prime City. Western on spot is quoted at 55c. to 56c.

Spelter—The market continues unsatisfactory and nominal at 4.55c. to 4.60c.

Tin—The spot market is firmer at 19.65c., with sales of 25 tons at that. The situation is considered very dull.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Mech'l eng'r desires position as foreman or draftsman with some m'f'g concern. N. S. H., care A. M.

Agents in every shop to sell the best surface gauges, etc., for part adv. E. G. Smith, Columbia, Pa.

Draftsman—Tech. educated machinist wants situation as assistant. Machinist, P. O. Box 1592, Phila.

Bookkeeper, practical, expd. with iron founders and machinists, wants work. Box 74, AM. MACH.

Wanted—Position in a drafting room by a young draftsman who desires advancem't. P.J., AM. MACH.

Experienced mechanical draftsman desires a position in N. Y. or vicinity. Box 75, AM. MACHINIST.

Position wanted by a young man who is a first-class metal pattern maker; best of references. Box 77, AMERICAN MACHINIST.

Wanted—Situation by an all-round machinist accustomed to handling men and tools to produce work at least possible cost. Box 78, AM. MACH.

Wanted—First-class foundry foreman, must be used to heavy engine castings. Address Box 68, care AMERICAN MACHINIST.

Wanted—Two or three good men accustomed to fitting and finishing large iron patterns and core boxes. The H. B. Smith Co., Westfield, Mass.

Wanted—Two or three good machinists for vise work in machine shop. Apply or address Kenney & Co., Scottdale, Pa.

Wanted—Draftsman exp. in the designing of modern steam pumping mach'y. Apply stating age, exp. and salary expected to Ohio, AM. MACHINIST.

A first-class designer and builder of special tools wants position; at present have charge of electric shop. Address Box 73, AMERICAN MACHINIST.

Wanted—Position as draftsman by an apprenticed mechanic, with tech. education and exp. in drafting-room; age, 23. W. L. S., AM. MACHINIST.

Wanted—Two or three A1 machinists in general jobbing shop. Kidder Machine Co., Franklin Falls, N. H.

A young carriage-smith of 20 will work a month for an opportunity to learn the machinist's trade in a good shop. Address Reader, AMER. MACHINIST.

A young man (25) wants position as ass't engineer; has N. Y. license; good lathe hand and draftsman. S. W., AMERICAN MACHINIST.

Wanted—Position by mech. draftsman with large exp. in constructing hoisting mach'y for electric, hydraulic, steam and hand power; used to making calculations and estimates. Time, AM. MACHINIST.

Wanted—An A1 experienced energetic foreman, to take charge of building Corliss engines and heavy transmission machinery; give experience and full refs., and address Box 67, care AMER. MACHINIST.

Wanted—First-class foreman, competent to fill position of assistant superintendent, must understand manufacture of Corliss and high speed engines. Address Engine, care AM. MACHINIST.

Wanted—25 first-class machinists accustomed to Corliss and automatic engine work; steady work and good wages to the right men. Apply to Sioux City Engine Works, Sioux City, Iowa.

Wanted—One good first-class pattern maker to work on general patterns; good wages and steady work to a suitable man. Address Pattern, care AMERICAN MACHINIST.

Wanted—Immediately, general foreman for machine shop; eighty men; medium and heavy work; must be a hustler. Address with references and full particulars. Hustle, care AM. MACHINIST.

Wanted—By an experienced mechanic, 38 years of age, a position as superintendent with some energetic concern in the manufacture of machinery, etc.; particulars given on application. Box 66, AMERICAN MACHINIST.

Wanted—First-class machinery salesman for Chicago and vicinity; must be well up in machine tools; a good place for the right party with one of the largest manufacturers in the U. S. Address "Masheen," care AMERICAN MACHINIST.

A mechanical engineer in good position now, well experienced in marine work, steam and hydraulic engineering, 6 years shop and 10 years office experience, wants position as assistant superintendent or manager in or near New York. First-class references. Address Box 76, AMERICAN MACHINIST.

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Practical Instruction for Engineers and Steam Users.
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HEADQUARTERS FOR GEARS.
Book on Gears, - - - $1.50.
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JOB GEAR CUTTING OF ALL KINDS.
Spur, Bevel, Spiral, Ratchet, Worm, Rack, Elliptic, etc. Very small or large. Send for Catalogue.

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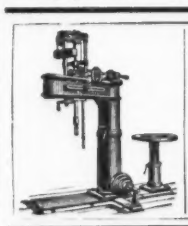
Americans or others desirous of having high class machinery or tools manufactured in England are invited to communicate with
GRENFELL & ACCLES, L'T'D.
HOLFORD ENGINEERING WORKS.
Perry Barr, Birmingham, England.
G. & A.'s extensive works are fitted throughout with the latest and best types of American machines and tools, and are conducted upon the American system, under the superintendence of American Engineers (formerly of Hartford, Conn.)

LIVE DRAFTSMEN
Send stamp for Catalogue of best time and labor-saving specialties. B. E. SAWYER, Athol, Mass.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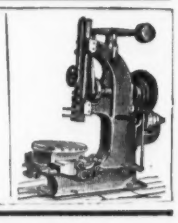

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A mechanical engineer; a capable and experienced manager with good executive ability is open for engagement. Exp'd in modern methods of manufacture, in interchangeable work, and in handling help; a successful designer of special and automatic mach'y; have had exp. in designing and erecting factories. A1 ref. Advancement, AM. MACH.

Wanted—Foreman for machine shop employing 25 to 30 men; principal work hoisting engines, mining machinery and general repairing; a live man is wanted, one who is used to handling men and machinery to the best advantage. To the right man a permanent situation is offered; give references and state salary expected; correspondence strictly confidential. Address B. W. Cooper, Litchfield, Ill.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd-lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

Best Portable Forge, $12. Am. Tool Wks., Clev., O.

Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

Special machinery designed and built. C. F. Langston & Co., 70 N. 4th St., Philadelphia.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

For Sale—Patent 465,676. High Duty Attachment for Steam Pumps; 100,000,000 Duty. H.D., AM. MACH.

Mechanics send for price lists of tools manufactured by Fred. A. Welles, Milwaukee, Wis.

Cheap—Two H. P. Engine Blue Prints complete. Designed to be built on an ordinary lathe. W. A. Smith & Co., 227 Eddy Street, Providence, R. I.

Manufacturers of traction engines and stump pulling machines send catalogue and prices to A. H. Frank at Pinellas, Florida.

To Capitalists—Valuable patent boiler either for sale or form stock company; big orders ahead. Address BOX 71, care AMERICAN MACHINIST.

A Bargain—Four horse-power Chandler Water Motor; best water motor made; been used about a year; cost $300; will sell for $150. Angier Chemical Co., Boston, Mass.

Wanted—An energetic, practical man as partner and manager of a new engine company; must have experience in selling engines; cap'l required $30,000; give refs., age, etc. M. Ulrich, Florence, Mass.

Bound volumes for 1891. We are now prepared to take orders. Price, $4.00 per volume; express charges payable by purchaser. Address AMERICAN MACHINIST, 96 Fulton street, New York.

Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent, Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

Machine Tools in Stock.

ENGINE LATHES.

78 in. swing,	9 ft. between centers		Sellers
38 do	17 ft. bed.	New	Fifield
30 do	14 do	do	do
28 do	12 do	do	
27 do	16 do	do	
24 do	12 do	do	Fifield
24 do	12 do	do	Fitchburg
24 do	12 do	do	Flather
22 do	10 do	New Pattern	Fifield
22 do	12 do	do	do
22 do	12 do	New	Blaisdell
22 do	8 do	do	Flather
22 do	10 do	do	do
20 do	8 do	do	do
20 do	10 do	do	do
18 do	8 do	do	do
18 do	10 do	do	do
18 do	8 do	do	Blaisdell
18 do	15 do	do	do
16 do	6 do	do	Flather
16 do	6 do	do	Blaisdell
15 do	6 do	do	Flather
14 do	6 do	do	do
14 do	6 do	do	Blaisdell
12 do	6 do	do	do

PLANERS.

42 in. wide,	42 in. high,	12 ft. long,	2 heads	Gleason
36 do	36 do	8 do		Pease
30 do	30 do	8 do		do
30 do	30 do	8 do		Whitcomb
30 do	30 do	8 do		Flather
26 do	26 do	6 do		do
24 do	24 do	6 do		do
24 do	24 do	6 do		Whitcomb
22 do	22 do	5 do		do
22 do	22 do	6 do		Flather

SHAPERS.

12, 16, 20 and 24 inch stroke	Eberhardt
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400 H. P. second-hand Corliss Engine for sale; also one 200 H. P. Brown Automatic and 200 H. P. Slide Valve Engine with Throttling Governor. All in good order and cheap for cash.

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This is the same as our No. 2, except it is smaller.
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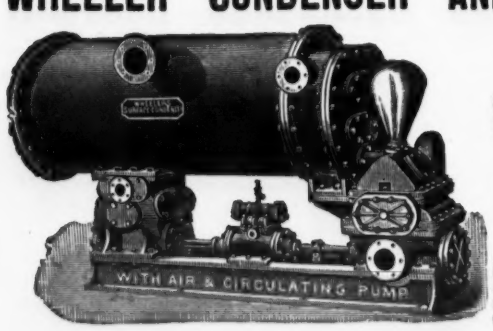

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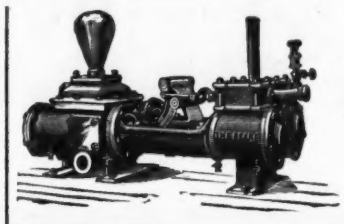

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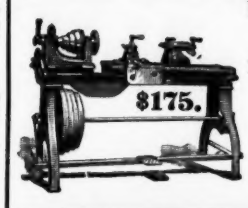

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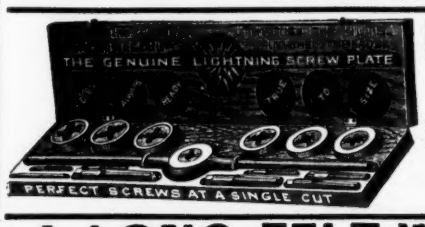

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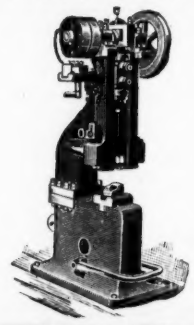

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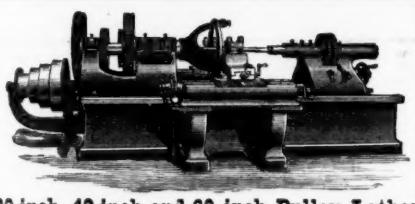

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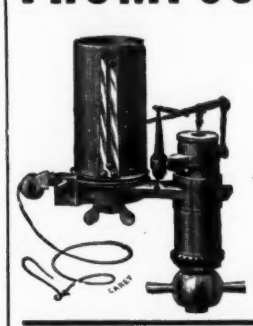

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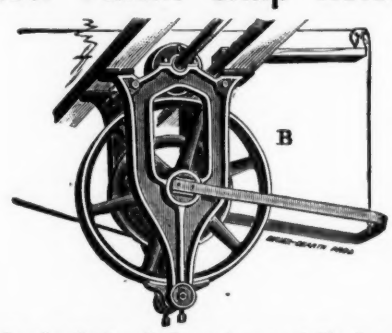

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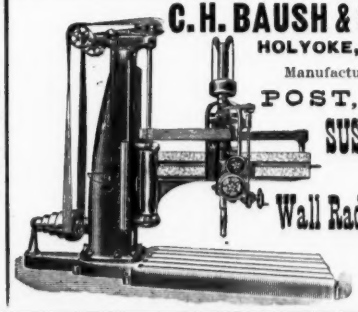

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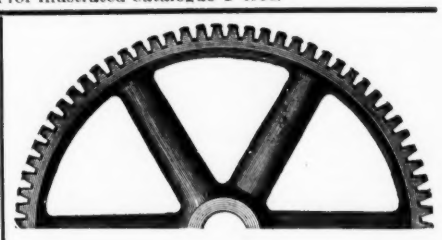

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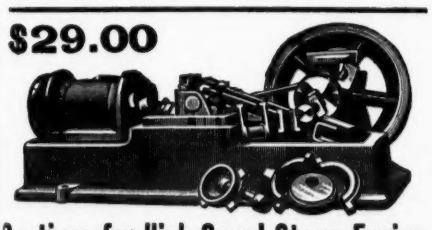

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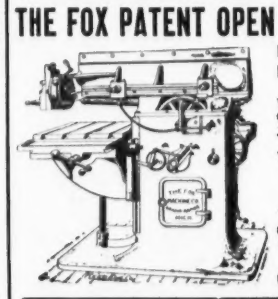

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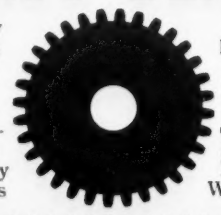

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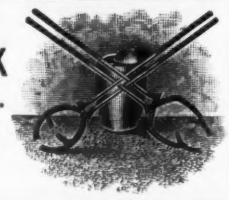

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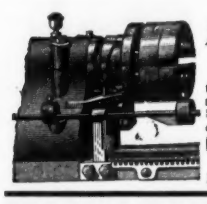

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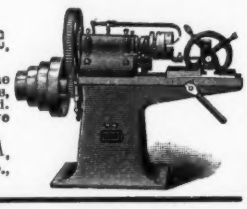

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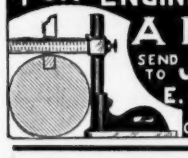

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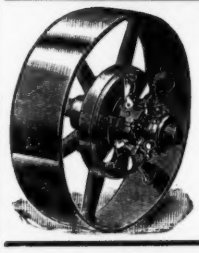

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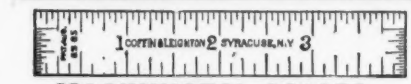

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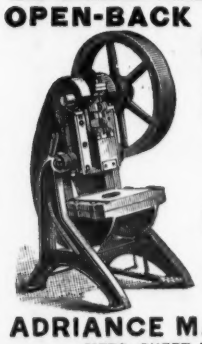

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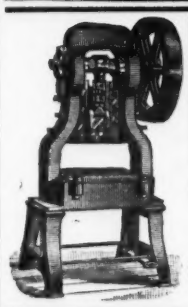

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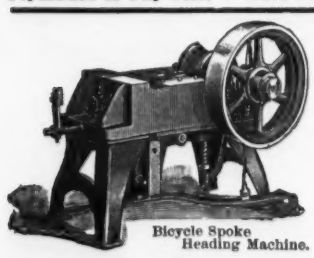

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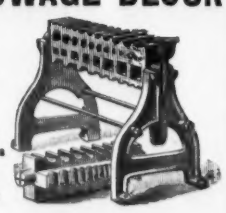

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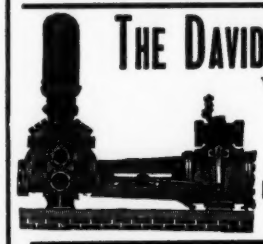

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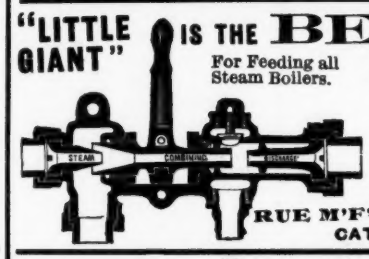

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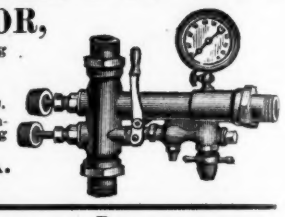

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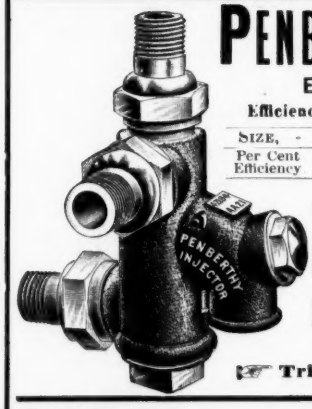

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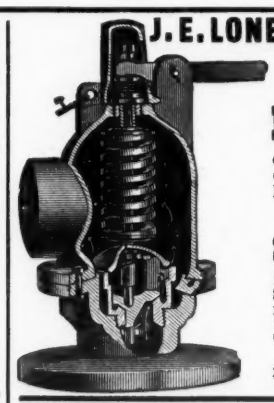

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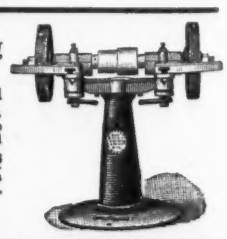

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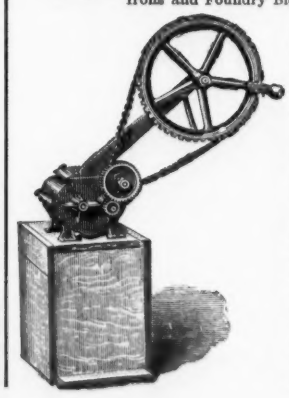

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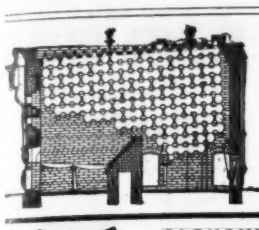

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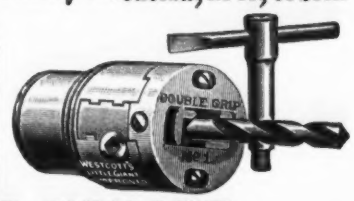

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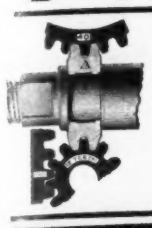

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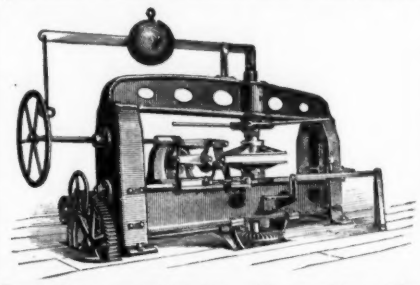

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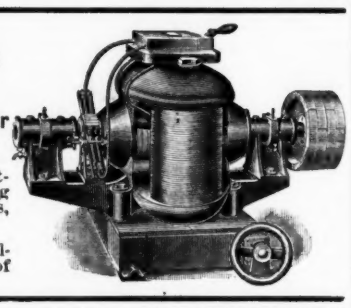

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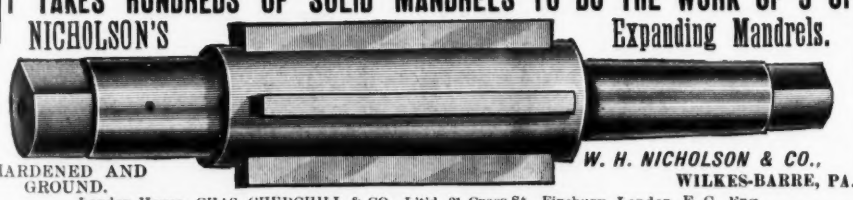

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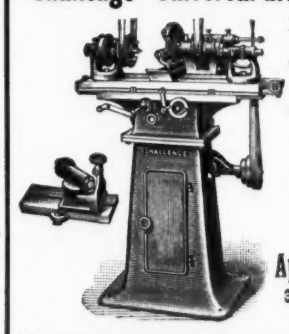

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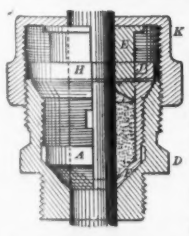

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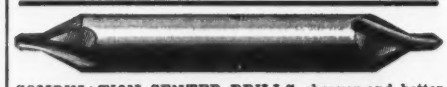

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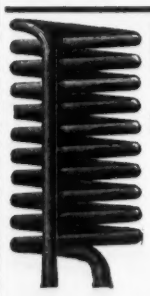

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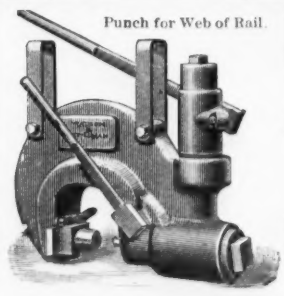

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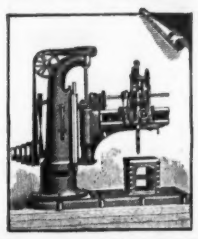

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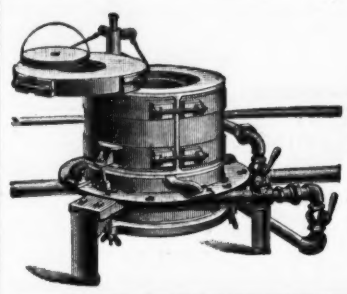

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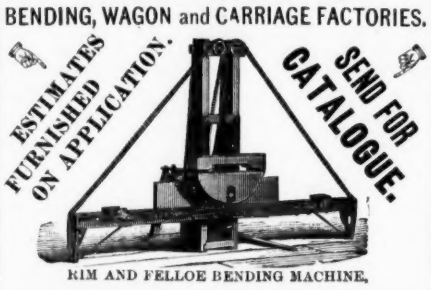

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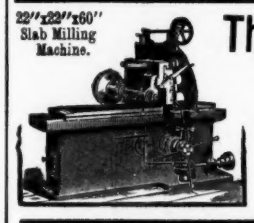

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THE BRADFORD MILL CO.,
EDWARD A. MILLER.

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For rolling trade-marks on flat or round Iron or Steel surfaces. Used by Cutlery Pistol, Twist Drill, Wrench, and many other mfrs. 200 in use. Read up. Catalogue "B" free.
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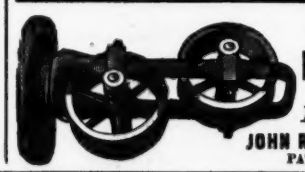

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GEO. D. WALCOTT & SON,
Manufacturers of
LATHES AND SHAPERS,
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Write us for Photo and Prices.

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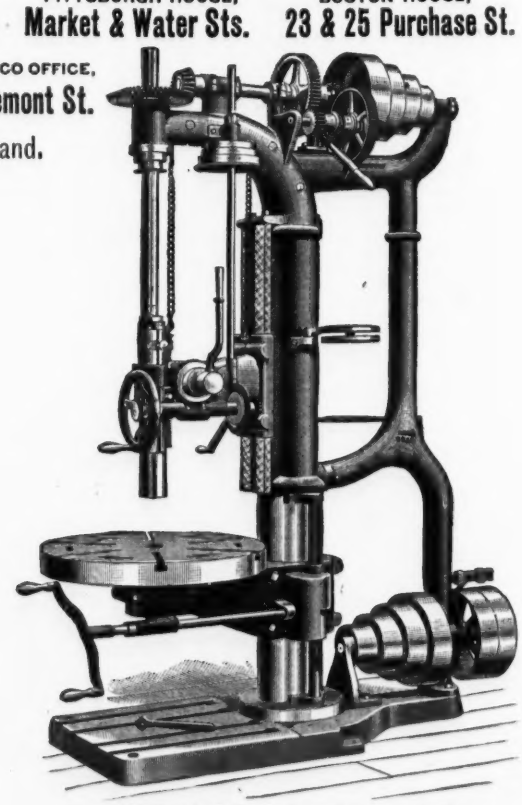

28-32-36-42-inch Back Geared Power Feed.

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Manufacturers of Morse Patent Straight-Lip Increase Twist Drills. New Bedford, MASS.

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
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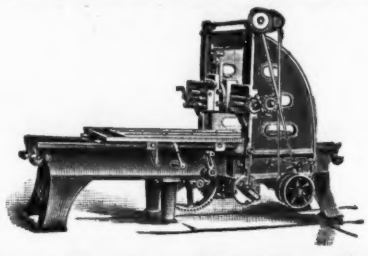

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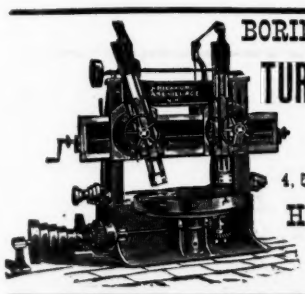

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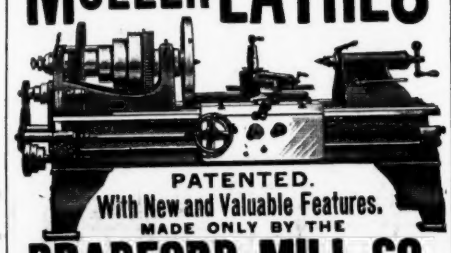

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With New and Valuable Features.
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Extra Heavy. Latest Design. All Modern Improvements.
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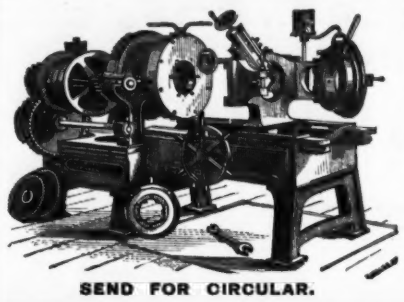

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Manufacturers of
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For Pipe, Mill and Steam Fitters' Use.
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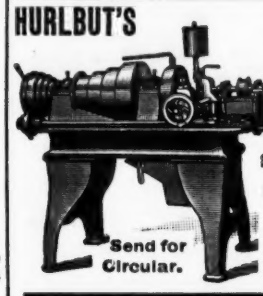

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Complete line, ranging from our New Friction Disk Drill, for light work to 42-inch Back Geared Self Feed Drill.
Send for Catalogue and Prices.
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Having just removed to 177, 179, 181 East Pearl Street, this city, where, with more commodious quarters and facilities, we are in still better shape to manufacture our specialty.
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Turret Drill Press
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Drills from $\frac{1}{16}$ to $\frac{1}{4}$ hole speed from 250 to 2000 Rev.
Suitable for a large variety of work and is operated with ease and rapidity.
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Lathes from 10 in. to 20 in. swing. Largest Variety of Drills manufactured in the world
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TOOLS AND MACHINERY.
BRASS FOUNDERS
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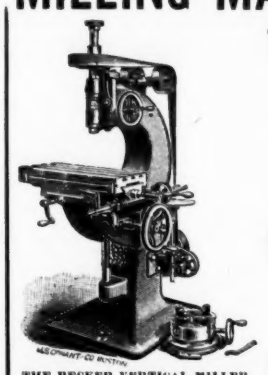

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Price $8
NO GAUGES. NO BELT.
Every Machine Guaranteed.

BARKER'S IMPROVED CENTER GRINDING MACHINE.
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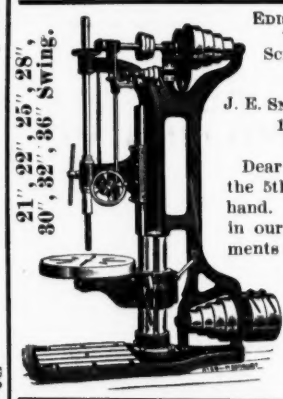

21", 25", 28", 30", 32", 36" Swing.

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J. E. SNYDER, Esq.,
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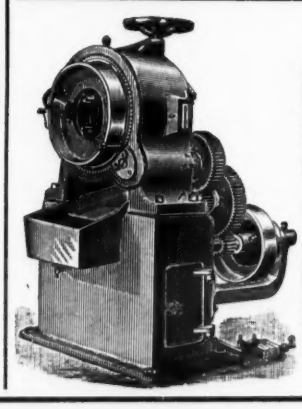
Dear Sir:—Your letter of the 5th inst. came duly to hand. We are now using in our various establishments 60 of your drills, and are very well pleased with them.

Yours very truly,
JOHN KRUESI,
Gen'l Manager.



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Pipe Cutting and Threading Machinery,
FOR HAND OR POWER.
RATCHET DRILLS, RATCHET DIE STOCKS AND MALLEABLE IRON PIPE VISES.

WE ARE OPEN TO CONTRACT FOR FINE MACHINE WORK.

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JOB WORK DESIRED.

The "Simplex" Glass-Tube Cutter.
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Or sent by mail to any address upon receipt of a P. O. Money Order for 32 CENTS.
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CHEAPEST AND BEST BOLT CUTTERS.

EVERY SIZE & STYLE.
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BUILDERS OF
MACHINE TOOLS FOR WORKING IRON AND STEEL.
Improved TURNTABLES for LOCOMOTIVES, CARS and PIVOT BRIDGES.
High Speed Power Traveling Cranes and Hand or Power Swing Cranes, Shafting, Pulleys, Hangers, &c., for transmission of power. Improved Self-Adjusting Injector of 1876. Self-Acting Injector of 1887. Fixed-Nozzle Automatic Injector of 1885.
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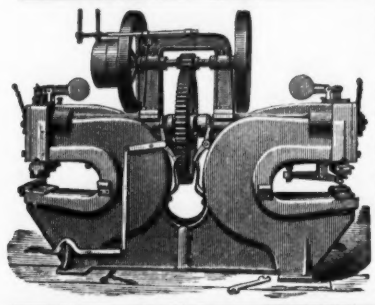

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Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven
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OVER 300 SIZES.
ALSO
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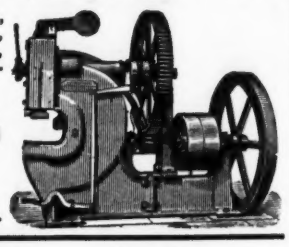
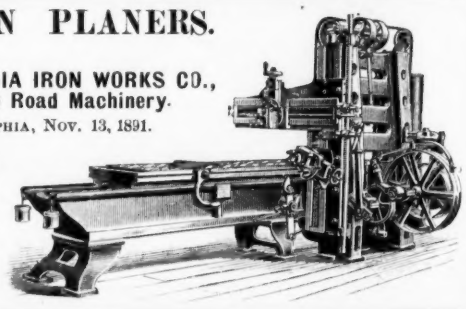
Send for New Catalogue.



THE OPEN SIDE IRON PLANERS.
THE DETRICK & HARVEY MACHINE CO., Baltimore, Md.
PENNSYLVANIA IRON WORKS CO., Cable Road Machinery.
PHILADELPHIA, Nov. 13, 1891.
GENTLEMEN: Owing to almost continued absence of the writer, your letter of October 27th has not been given earlier attention.
We would now state, however, that the Open Side Planer, which we purchased of you, has been in continual use since its purchase, and has given us entire satisfaction.
Very truly yours,
PENNSYLVANIA IRON WORKS CO.,
B. W. GRIST, General Manager.



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Cutting from 1-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.
FIRST PREMIUM, CINCINNATI CENTENNIAL.

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STEEL CASTINGS
FROM 1-4 TO 15 000 LBS. WEIGHT.
True to pattern, sound, solid, free from blow-holes and of great strength.
Stronger and more durable than iron forgings in any position or for any service whatever.
60,000 CRANK SHAFTS and 50,000 GEAR WHEELS of this steel now running prove this.
Crossheads, Rockers, Piston-Heads, etc., for Locomotives.
STEEL CASTINGS of every description.
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Investigate Lunkenheimer's Patented Regrinding Valves. When worn can be made good as new by regrinding or the disk replaced. Warranted to outlast two of any other make. As a proof of their superiority, are extensively used on Locomotives, Steamships and in the U. S. Navy on Cruisers. Every genuine valve has a direction tag attached, and "LUNKENHEIMER" and "S)" cast in the valve-shell and fully warranted. For sale by dealers, or write us. **Mention this Paper.**
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Our Catalogue of Superior Steam Specialties, such as Valves, Sight Feed Lubricators, Glass Oil and Grease Cups, Etc., will interest you. Write for one.

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WITH GROUND AND GRADUATED VIAL.
4-6 & 8 inch.

Three Sizes.
MANUFACTURED BY
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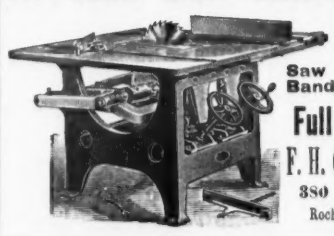

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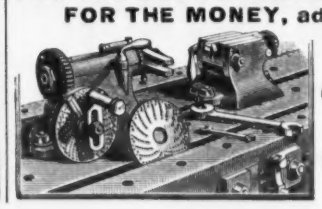

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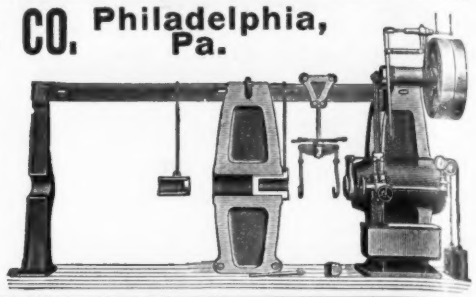

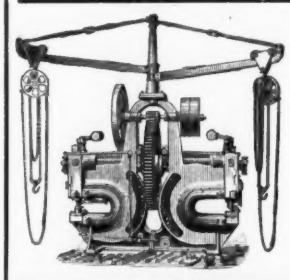

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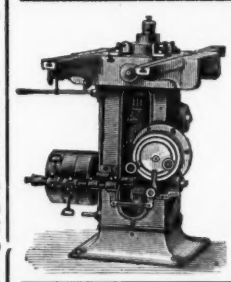
If you buy a KEY-WAY CUTTER without a KEY-MAKING ATTACHMENT
You will make a mistake that will cost you money.

THE MORTON Lightning Key-Way Cutter is the only machine on the market that will cut a Key-Way and make a Key to fit it. Mr. Geo. Newcomb, Salem, Mass., says as follows: "The Key-maker is a wonderful attachment, making keys faster than a man can cut off the steel for it. The Key-Way Cutter does a piece of work in fifteen minutes which requires my man seven hours to accomplish by hand." We build machines with stroke varying from six inches to five feet, and cutting from the smallest Key-ways to six inches wide. MORTON MFG. CO., Muskegon, Mich. Formerly of ROMEO, MICH.



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Portable and Stationary.
Back-Cutting Attachment
Key-Making Machines.
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April 25, 1891. We are very much pleased with it, and think it the best machine on market for simplicity and effective work. DAVIS & COWGILL IRON WORKS, Omaha, Neb.

THE ERIE KEY-SEATING MACHINE.
MANUFACTURED BY
THE BURTON MACHINE CO.,
302 Peach St.,
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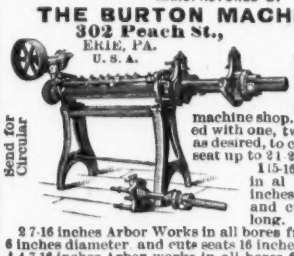

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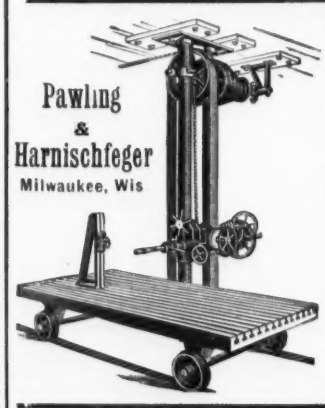
1 15-16 inches Arbor works in al bores from 1 15-16 inches to 3 inches diameter and cuts seats 12 inches long.
2 7-16 inches Arbor Works in all bores from 2 7-16 inches to 6 inches diameter and cuts seats 16 inches long.
4 7-16 inches Arbor works in all bores from 4 7-16 inches to 14 inches diameter, and cuts seats 36 inches long.
With an attachment for the purpose, seats can be cut in holes as small as 1 inch diameter, by one passage of the cutter.
If the work is heavy and too large to be placed on machine it can be detached from stand and used as portable machine

Pawling & Harnischfeger
Milwaukee, Wis.



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Electric, Steam and Hand Cranes.

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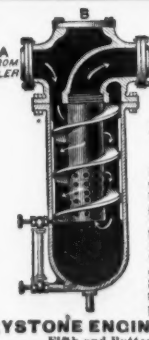

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For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.
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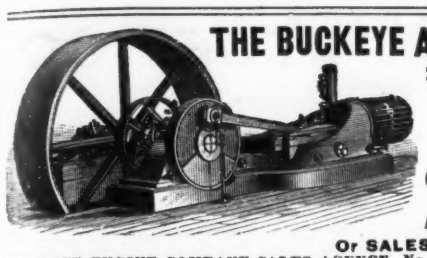

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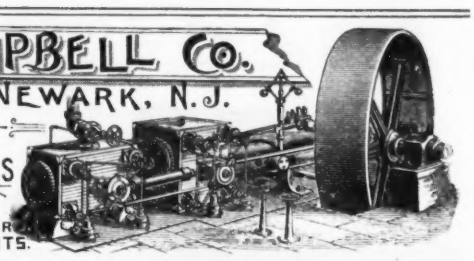

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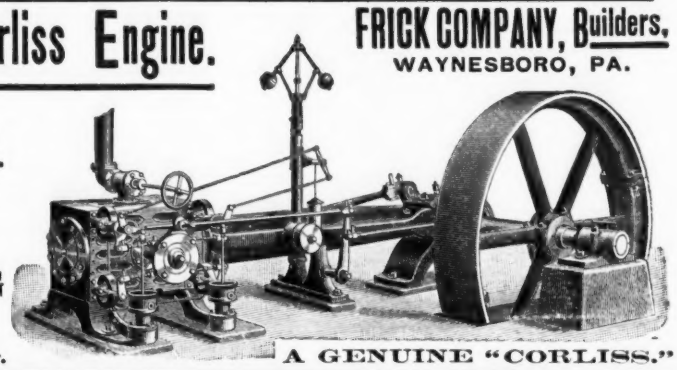

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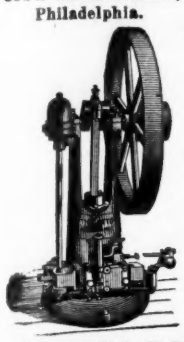

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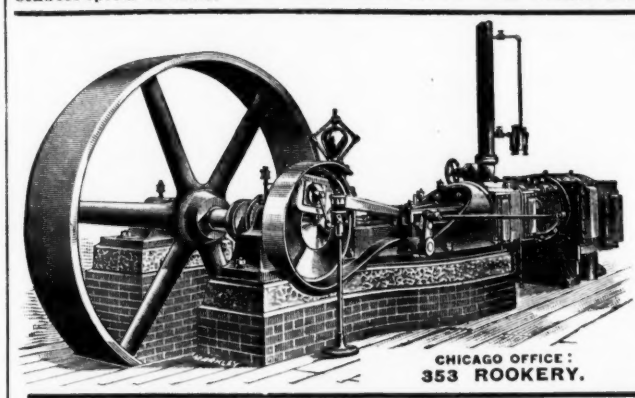

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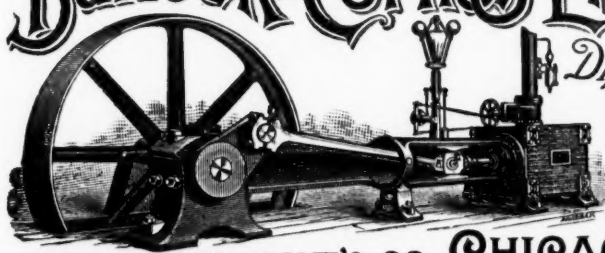

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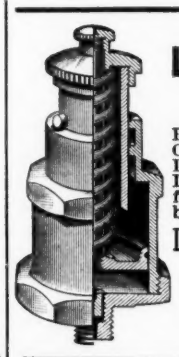

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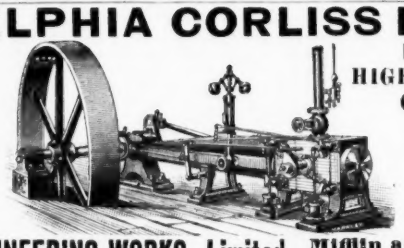

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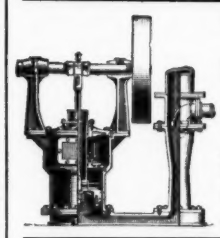

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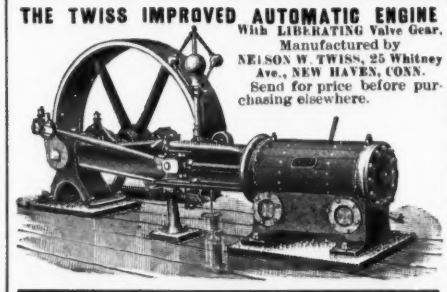

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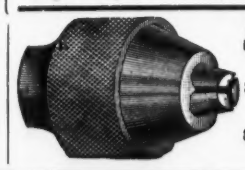

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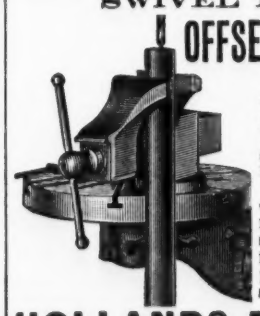

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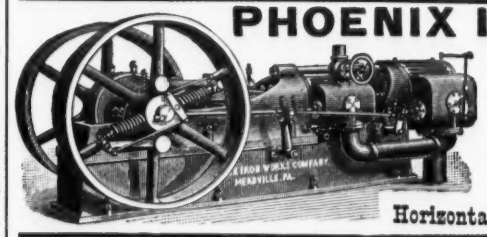

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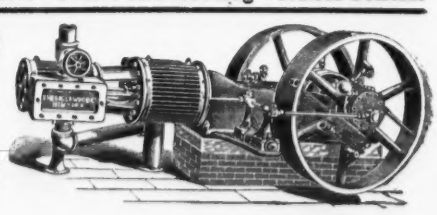

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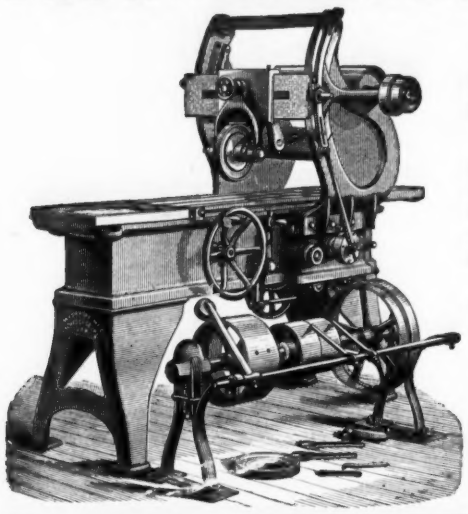

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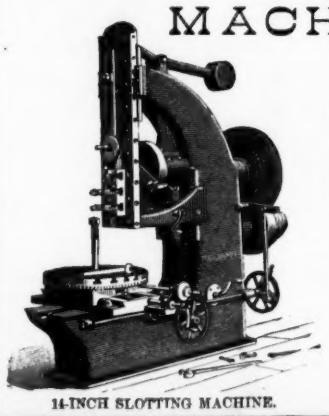

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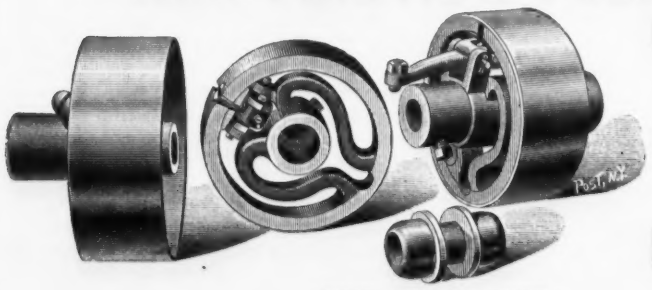

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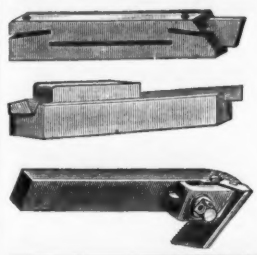

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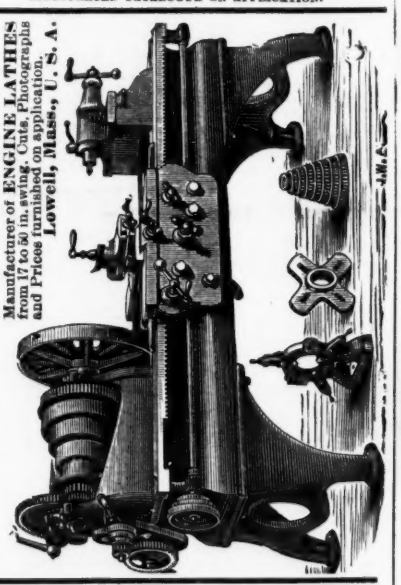

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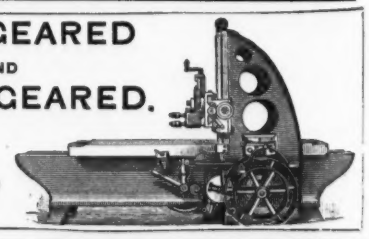

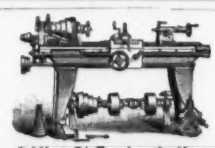

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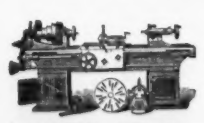

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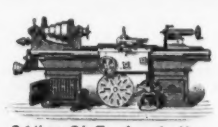

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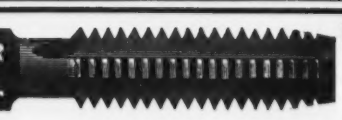

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